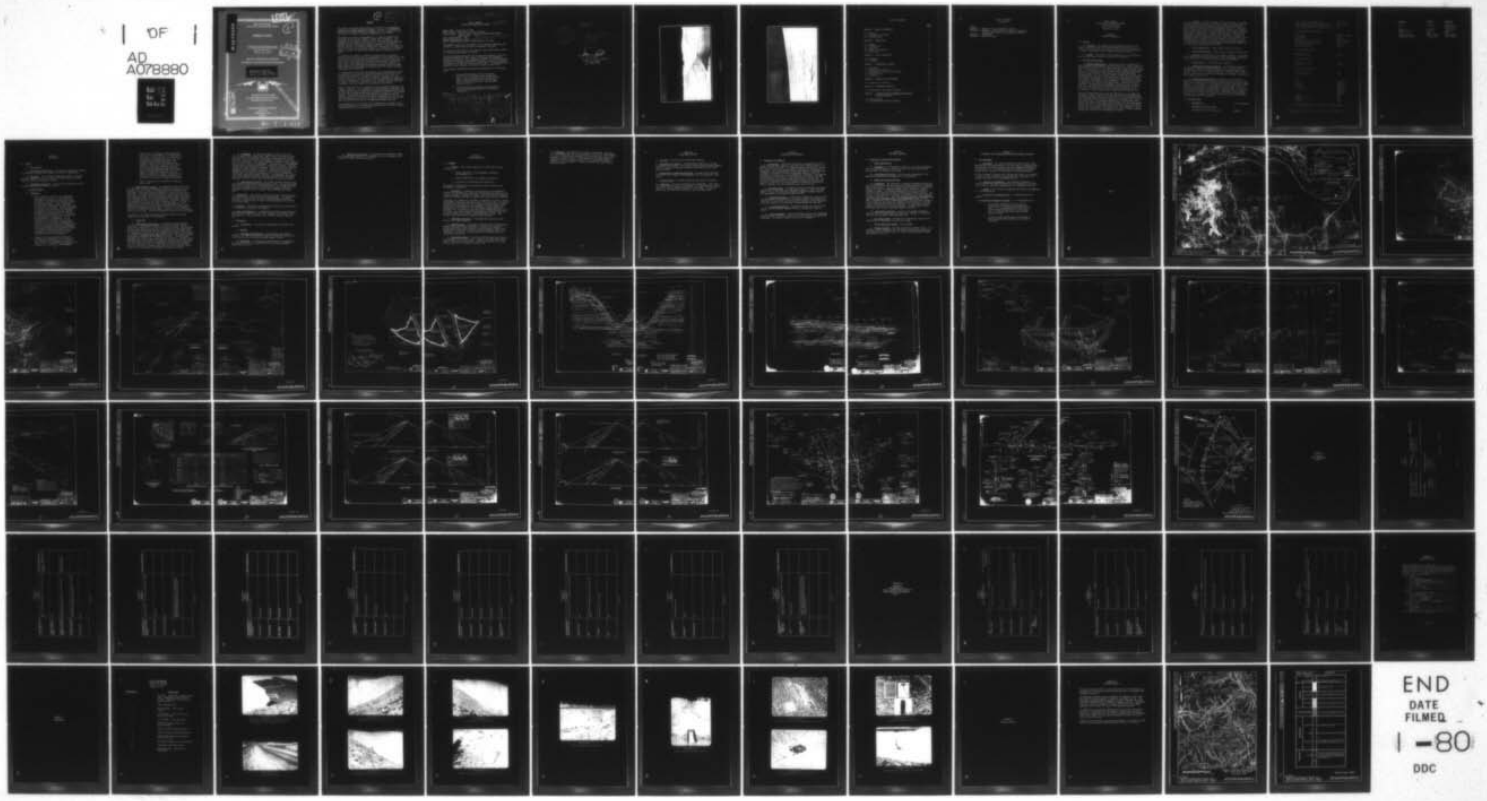
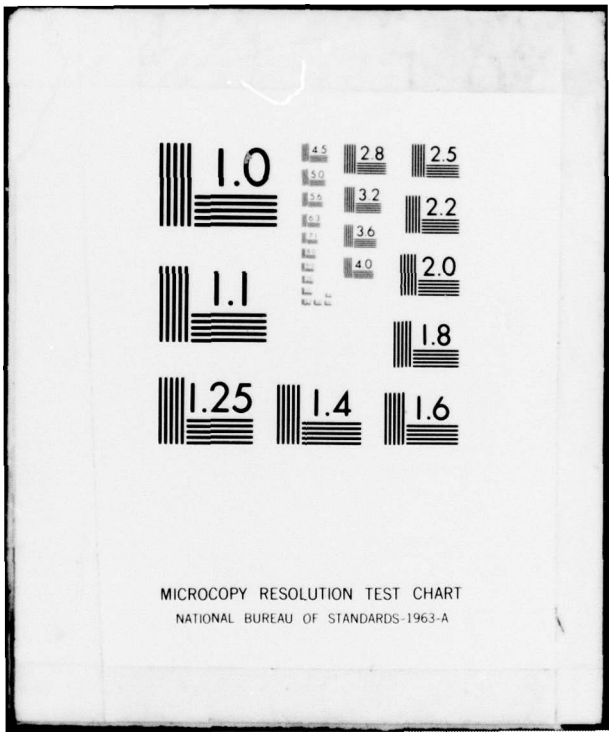
AD-A078 880 D'APPOLONIA CONSULTING ENGINEERS INC PITTSBURGH PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. LITTLE BLUE RUN DAM (NDI ID NU--ETC(U)
JUN 79 L D ANDERSON DACW31-79-C-0014
UNCLASSIFIED NL

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NATIONAL BUREAU OF STANDARDS-1963-A

LEVEL

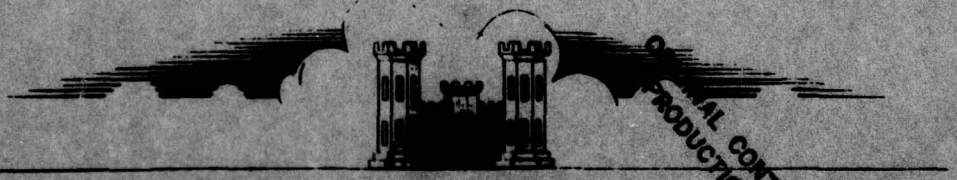
OHIO RIVER BASIN
LITTLE BLUE RUN, BEAVER COUNTY

PENNSYLVANIA

LITTLE BLUE RUN DAM

NDI I.D. NO: PA-917
DER I.D. NO: 4-49

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235

JUNE 1979

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigation and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

(10) Laurenee D. Anderson

(11) Jun 79

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

(12) 81

NAME OF DAM: Little Blue Run Dam
STATE LOCATED: Pennsylvania and West Virginia
COUNTY LOCATED: Beaver County, Pennsylvania and Hancock County, West Virginia
SIZE CLASSIFICATION: Large
HAZARD CLASSIFICATION: High
(15) DACW31-79-C-0014
DATE OF INSPECTION: March 14, ~~1979~~ and April 16, 1979

ASSESSMENT: Based on the evaluation of the existing conditions, the condition of Little Blue Run Dam is considered to be good.

No conditions were noted at this time that would significantly affect the structural performance of the dam.

The flood discharge facilities for the dam were designed to pass the probable maximum flood (PMF) without overtopping the embankment. Therefore, according to the recommended criteria, the flood discharge facilities of the dam are adequate. Presently, the pool elevation is approximately 170 feet below the dam crest level. The pool elevation is expected to reach spillway crest level in about the year 2010.

The following recommendations should be implemented on a continuing basis:

(1) The cracking observed on the crest should continue to be evaluated by the design engineers. Also, attention should be given to the slump and seepage observed on the left abutment. Erosion ditches on the right abutment should be filled; and

(2) A formal warning system should be developed to alert the downstream residents in the event of emergencies.

(6) National Dam Inspection Program. Little Blue Run Dam (NDI ID PA 917, DER ID 4-49), Ohio River Basin, Little Blue Run, Beaver County, Pennsylvania. Phase I Inspection Report,

411001

Lawrence D. Andersen, P.E.
Vice President

9 AUG 1979
Date

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

11 Sep 79
Date

Upstream Face

Downstream Face

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(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
LITTLE BLUE RUN DAM
NDI I.D. NO. PA-917
DER I.D. NO. 4-49

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. Little Blue Run Dam consists of an earth embankment approximately 2100 feet long with a maximum height of approximately 400 feet from the downstream toe and a crest width of 50 feet. The dam serves as a fly ash and scrubber sludge disposal impoundment for the Pennsylvania Power Company's Bruce Mansfield Generating Station located along the Ohio River near the Pennsylvania/West Virginia border. The fly ash and scrubber sludge from the power plant are initially mixed with a stabilizing agent, then pumped and deposited behind the embankment. The slurry is discharged into the reservoir through a floating pipeline arrangement. The stabilized sludge is expected to set within a few weeks after its disposal into the reservoir. The reservoir was designed to impound 20 feet of water above the stabilized sludge level under normal operating conditions. On the date of inspection, the pool level was reported to be at Elevation 927 and the sludge level at approximately Elevation 860.

The flood discharge facilities for the dam consist of a primary and emergency spillway located on the left abutment (looking downstream). The primary spillway structures consist of a concrete intake structure and a concrete pipe which will convey flows from normal pool level to the valley floor. The emergency spillway is a 30-foot-wide trapezoidal open channel which will freely discharge over the left abutment into the valley. The impoundment has no low-level outlet facilities because the rising sludge level would render them inoperable. Excess inflow into the reservoir is returned to the river through a pumping system with a capacity of 3600 gallons per minute.

b. Location. The dam is located on Little Blue Run, a secondary tributary of the Ohio River at the West Virginia and Pennsylvania state line between Greene Township, Beaver County, Pennsylvania, and Grant Township, Hancock County, West Virginia (Plate 1). Below the dam, Little Blue Run flows north joining Mill Creek at its confluence with the Ohio River about 1.2 miles southwest of Georgetown, Pennsylvania, and 2.5 miles east of Chester, West Virginia. There are no inhabitable structures in the Little Blue Run valley. Although the impounded sludge is stabilized and is not likely to flow freely, it is estimated that the release of the supernatant in the event of a dam failure would be likely to cause loss of life and property damage in the communities and industrial developments along the Ohio River and to river traffic downstream from the dam.

c. Size Classification. Large (based on 400-foot height).

d. Hazard Classification. High (based on downstream conditions).

e. Ownership. Pennsylvania Power Company (address: Pennsylvania Power Company, Bruce Mansfield Plant, Box 128, Shippingport, Pennsylvania 15077, Attn: Mr. Dale Billhimer, Production Engineer).

f. Purpose of Dam. Power plant waste disposal.

g. Design and Construction History. The geotechnical aspects of the dam were designed by General Analytics, Inc., of Monroeville, Pennsylvania, and the hydrology and hydraulics aspects were designed by Gibbs & Hill, Inc., of New York, New York in 1974 and 1975. The dam was constructed by the Dravo Corporation of Pittsburgh, Pennsylvania with completion in May 1977.

h. Normal Operating Procedure. Presently, the pool level is approximately 160 feet below the primary spillway crest elevation, and there are no operational procedures that would affect the flood storage capacity of the reservoir. The normal pool level is expected to reach spillway crest elevation in approximately the year 2010. At that time, the reservoir will be maintained at Elevation 1090, the level of the uncontrolled primary spillway crest, leaving 10 feet of freeboard to the top of the dam at Elevation 1100. The inflow occurring when the lake is at or above the primary spillway crest will be discharged through the uncontrolled spillway.

1.3 Pertinent Data

a. Drainage Area	2.93 square miles
b. Discharge at Dam Site (cfs)	
Maximum known flood at dam site	Unknown

Outlet conduit at maximum pool	Not applicable
Gated spillway capacity at maximum pool	Not applicable
Ungated spillway capacity at maximum pool	1700
Total spillway capacity at maximum pool	1700

c. Elevation (USGS Datum) (feet)

Top of dam	1100 (as designed)
Maximum pool	1100
Normal pool	1090(1)
Upstream invert outlet works	Not applicable
Downstream invert outlet works	Not applicable
Downstream toe of dam	700±
Maximum tailwater	Unknown

d. Reservoir Length (feet)

Normal pool level	11,000
Maximum pool level	11,500

e. Storage (acre-feet)

Normal pool level	64,900
Maximum pool level	73,000

f. Reservoir Surface (acres)

Normal pool level	770
Maximum pool level	850

g. Dam

Type	Rock-fill
Length	2100 feet
Height	400 feet
Top width	50 feet
Side slopes	Downstream: 2H:1V; Upstream: 2H:1V
Zoning	Yes
Impervious core	Yes
Cutoff	Yes
Grouting	Yes

h. Regulating Outlet. The dam has no regulating outlet.

(1) The pool is expected to reach this elevation in about the year 2010.

i. Spillway	Primary	Emergency
Type	Drop inlet	Trapezoidal earth channel
Length	15 feet	30 feet
Crest elevation	1090 feet	1092.5 feet
Gates	None	None
Upstream channel	Earth channel	Earth channel
Downstream channel	36-inch pipe	Earth channel

SECTION 2
DESIGN DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. The available information consists of an engineer's report and a summary of hydraulic computations.

(2) Embankment. The available information consists of design drawings, engineer's reports, construction specifications, boring logs, and construction progress reports.

(3) Appurtenant Structures. The available information consists of design drawings and engineer's reports.

b. Design Features

(1) Embankment

a. Plate 2 shows the layout of the embankment. As designed, the dam is a zoned, rock-fill embankment consisting of an inclined, impervious earth core and a filter blanket beneath the downstream slope. Filter zones were provided on the downstream and upstream sides of the earth core section. Plate 3 illustrates the typical cross section of the embankment. The impervious core cross section has been designed with constant slopes of 1.25H:1V on the upstream face and 1H:1V on the downstream face throughout the embankment. On the downstream side, the impervious core is followed by a filter and a central random rock-fill zone. Resistant to semiresistant rock-fill followed by resistant sandstone fill forms the downstream slope of the embankment. The upstream slope of the embankment consists of resistant sandstone material. Plate 4 illustrates the details of the internal drainage system for the embankment.

b. Design of the dam was based on extensive subsurface investigation in the vicinity of the embankment and throughout the reservoir area. Plate 2 illustrates the location of the borings in the vicinity of the embankment.

Plates 5 and 6 illustrate typical geological sections for the embankment. The valley walls and floors of Little Blue Run are underlain by rock strata of Middle Pennsylvanian Age, the Allegheny and Conemaugh formations. The Allegheny Formation consists primarily of sandstone, sandy shale, and shale with lesser amounts of claystone, limestone, and coal. The overlying Conemaugh Formation consists of shale, claystone, and sandy shale with lesser amounts of sandstone, limestone, and coal. Within the reservoir, bedrock is formed by the upper 220 feet of the Allegheny Formation and the lower 170 feet of the Conemaugh Formation.

c. Plate 7 illustrates the location of foundation grout holes.

(2) Appurtenant Structures. The appurtenant structures of the dam consist of a primary and emergency spillway located on the left abutment (Plate 8). Based on the expected rate of filling of the impoundment, these facilities are expected to be functional in the year 2010. The primary spillway structures consist of a 15-foot-wide earth approach channel and a 15-foot-wide concrete intake structure which discharges into a 36-inch reinforced concrete pipe. The invert of the primary spillway is at Elevation 1090. The primary spillway pipe terminates at the valley floor at Elevation 699.6. The pipe is equipped with a discharge structure at the downstream end. The emergency spillway is a 30-foot-wide trapezoidal earth channel which would freely discharge into the valley. The crest of the emergency spillway is located at Elevation 1092.5, leaving 7.5 feet of freeboard to the top of the dam. Plate 9 illustrates the profile of the spillways.

The dam has no low-level discharge facilities because the rising sludge level would render them inoperable.

c. Design Data

(1) Hydrology and Hydraulics. The emergency flood discharge facilities for the dam were designed to pass the probable maximum flood with a freeboard of 2.4 feet to the top of the dam. The probable maximum flood inflow hydrograph for the reservoir was determined based on the methods developed by the Soil Conservation Service (SCS) of the U.S. Department of Agriculture and modified by the Bureau of Reclamation as included in Design of Small Dams, 1960 edition. The probable maximum precipitation was taken as 33.8 inches in 24 hours. The PMF inflow hydrograph was found to have a peak flow fo 22,000 cfs. The PMF inflow hydrograph was routed through the reservoir starting from primary spillway crest level and produced a maximum pool level of 1097.6, leaving a 2.4-foot freeboard to the top of the dam. The primary spillway was sized to pass a flood resulting from a storm of 11.7 inches of precipitation in 24 hours without activating the emergency spillway.

(2) Embankment. The dam was designed by General Analytics, Inc., of Monroeville, Pennsylvania, based on the evaluation of extensive subsurface investigation, laboratory testing, and engineering analyses. Plate 10 illustrates the summary of laboratory test data for the core material. The design drawings and reports include similar data for other zones of the embankment. The stability of the embankment was analyzed for end-of-construction, steady-state seepage, horizontal sliding, and rapid drawdown conditions. The results of this stability analysis are shown on Plates 11 and 12. Seismic stability of the embankment was also analyzed based on a 0.1g seismic coefficient. The minimum factor of safety is reported to be 1.3 for the downstream slope under earthquake loading condition. The embankment has performance instrumentation installed, including piezometers and settlement monuments. Plates 13 and 14 show the location of these instruments.

(3) Appurtenant Structures. The primary spillway discharge pipe was designed to pass 90 cfs at maximum pool level. The pipe was sized such that open-channel flow can be maintained at the design discharge. The pipe is equipped with air vents along its length to maintain atmospheric pressure within the pipe, thus providing open-channel flow.

2.2 Construction. The dam was constructed by Dravo Corporation under the supervision of General Analytics field personnel. No reference was found to indicate that any unusual problems were encountered during the construction of the dam. As-built drawings are available in the state files.

2.3 Operation. The dam has no operational features that would affect its structural and hydraulic performance.

2.4 Other Investigations. A cracking and settlement problem that was observed on the crest of the dam after completion is currently under investigation by GAI Consultants, Inc. (formerly General Analytics, Inc.).

2.5 Evaluation

a. Availability. The available information was obtained from PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. The hydrologic and hydraulic design of the flood discharge facilities for the dam was found to be in conformance with the current spillway design criteria.

(2) Embankment. The design and construction of the embankment are considered to be in conformance with the currently accepted engineering practices.

(3) Appurtenant Structures. The structural and hydraulic design of the appurtenant structures is considered to be in conformance with currently accepted engineering practices.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Little Blue Run Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the spillway structures.

3. Evaluation of downstream hazard potential.

The specific observations are illustrated on Plate 15 and in the photographs in Appendix C.

b. Embankment. In general, the inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, erosion, and other surficial features.

In general, the condition of the dam is considered to be good. Several longitudinal cracks were observed on the crest of the dam. The owner's representative indicated that this cracking problem is being closely monitored and investigated by the designers. Several slumps and a seepage area were observed on the left abutment approximately at Elevation 740. Flow from the seep is being collected and monitored by the owner. The design engineer's representative indicated that this slumping problem is also being closely monitored by them. Some surface erosion was observed along the right abutment.

c. Appurtenant Structures. The appurtenant structures were found to be in good condition.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered with woodlands. A review of the regional geology (Appendix D) indicates that the shorelines are likely to be susceptible to landslides. However, massive landslides which would significantly affect the storage volume of the reservoir are not considered to be likely.

e. Downstream Channel. The Little Blue Run joins Mill Creek at its confluence with the Ohio River. There are no inhabitable structures in this reach of the stream. Further description of the downstream conditions is included in Section 1.2b.

3.2 Evaluation. The condition of the dam is considered to be good. It is recommended that the cracking problem on the crest, which appears to be due to differential settlement of the various rock zones of the embankment, should continue to be evaluated by the design engineers. Similarly, attention should be given to the slumping and seepage problem on the left abutment. Erosion ditches on the right abutment should be filled.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. The dam has no operational features.

4.2 Maintenance of the Dam. The maintenance condition of the dam is considered to be good. The erosion ditches along the right abutment should be filled and necessary diversion performed to avoid future erosion problems.

4.3 Maintenance of Operating Facilities. The dam has no operating facilities as it relates to the embankment and its appurtenant structures.

4.4 Warning System. No formal warning system exists for the dam.

4.5 Evaluation. The dam is satisfactorily maintained. Other than the erosion problem on the right abutment, no conditions were observed that would require immediate attention at this time. It is recommended that the owner should develop a formal warning system.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Little Blue Run Dam has a watershed area of 2.9 square miles and would impound a reservoir with a surface area of 770 acres at normal pool level. The flood discharge facilities for the dam were sized to pass the probable maximum flood without overtopping the embankment. The probable maximum flood hydrograph was determined based on methods developed by the Soil Conservation Service of the U.S. Department of Agriculture, and as modified by the Bureau of Reclamation, corresponding to 33.8 inches of precipitation in 24 hours. The PMF inflow hydrograph was found to have a peak inflow of 22,000 cfs. The PMF inflow hydrograph was routed through the reservoir starting from primary spillway crest level and produced a maximum pool elevation of 1097.6, leaving a 2.4-foot freeboard to the top of the dam.

b. Experience Data. As previously stated, Little Blue Run Dam is classified as a large dam in a high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass full PMF.

c. Visual Observations. On the date of inspection, the pool level was approximately 160 feet below the primary spillway crest elevation. According to the forecast rate of reservoir filling, the spillway structures are expected to be functional in approximately the year 2010.

d. Overtopping Potential. The design calculations indicate that the dam can pass probable maximum flood at a maximum pool level of 1097.6.

e. Spillway Adequacy. Since the spillway can pass the recommended spillway design flood of 100 percent of the PMF without overtopping the embankment, the spillway capacity is rated to be adequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, the field observations did not reveal any signs of distress at this time that would significantly affect the stability of the dam.

(2) Appurtenant Structures. The structural performance of the appurtenant structures is considered to be satisfactory.

b. Design and Construction Data

(1) Embankment. The review of the available information indicates that the design of the dam was based on extensive laboratory testing and engineering analysis. The slope stability calculations for the dam were carried out using the computer program, SLOPE, of McDonnel Douglas Automation Company. The program determined the factor of safety for circular failure surfaces by both the Bishop and Fellenius methods. The results of the stability calculations are included in a report prepared by General Analytics, Inc., entitled, Stability Analysis, Impoundment Dam, Little Blue Run Development Area, Dravo Corporation, dated July 22, 1974. In addition to this stability analysis, the horizontal sliding of the dam along the dam-foundation interface and the analysis of sliding along a claystone layer were also examined. All calculated factors of safety were reported to exceed the required 1.5 under static loading conditions and 1.0 under earthquake loading conditions.

(2) Appurtenant Structures. Review of the design information indicates that the appurtenant structures were designed in conformance with currently accepted engineering practices.

c. Operating Records. The dam has no operational features that would affect the structural stability of the dam.

d. Post-Construction Changes. None reported.

e. Seismic Stability. The dam is located in Seismic Zone 1. The engineer's report indicates that the seismic stability of the dam was considered and the minimum factor of safety under earthquake loadings was reported to be 1.3.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations indicate that Little Blue Run Dam is in good condition. At this time, no conditions were observed that would significantly affect the overall performance of the structure. It is recommended that the differential settlement problem should continue to be evaluated by the design engineer.

The flood discharge facilities for the dam were found to be designed to pass full PMF. Therefore, the spillways are classified to be adequate according to the recommended criteria.

b. Adequacy of Information. The available information, in conjunction with the visual observations, is considered to be sufficient to make a reasonable assessment of the condition of the dam.

c. Urgency. The following recommendations should be implemented on a continuing basis.

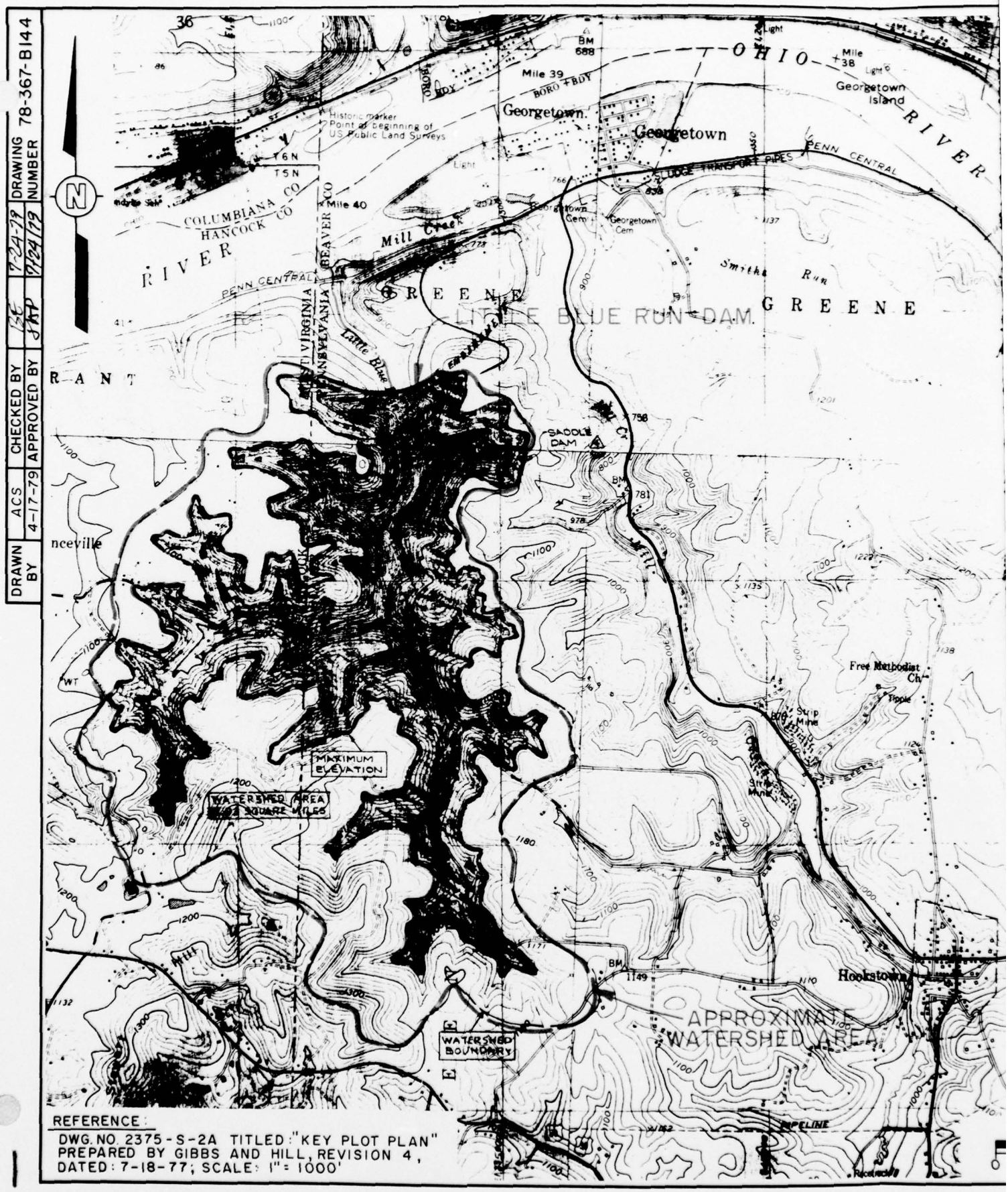
d. Necessity for Additional Data. No additional data are required.

7.2 Recommendations/Remedial Measures. It is recommended that:

1. The cracking observed on the crest should continue to be evaluated by the design engineers. Also, attention should be given to the slump and seepage observed on the left abutment. Erosion ditches on the right abutment should be filled.

2. A formal warning system should be developed to alert the downstream residents in the event of emergencies.

PLATES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CHECKED BY
APPROVED BY
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Georgetown
Georgetown Island
Mile 38
Mile 39
Mile 40
BM 688
BORO + BDY
Historic Marker
Point of beginning of
U.S. Public Land Surveys
T6N
T5N
COLUMBIANA CO
HANCOCK CO
BEAVER CO
PENNSYLVANIA
VIRGINIA
WEST VIRGINIA
RIVER
PENN CENTRAL
PENN CENTRAL PIPES
SLUDGE TRANSPORT PIPES
Mill Creek
Georgetown Cem
Smiths Run
GREENE
GREENE
LITTLE BLUE RUN DAM
Little Blue Run
SADDLE DAM
BM 781
Free Methodist Ch
Strip Mine
Hookstown
MAXIMUM ELEVATION
WATERSHED AREA 2 SQUARE MILES
WATERSHED BOUNDARY
APPROXIMATE WATERSHED AREA
PIPELINE
REFERENCE:
DWG. NO. 2375-S-2A TITLED: "KEY PLOT PLAN"
PREPARED BY GIBBS AND HILL, REVISION 4,
DATED: 7-18-77; SCALE: 1" = 1000'

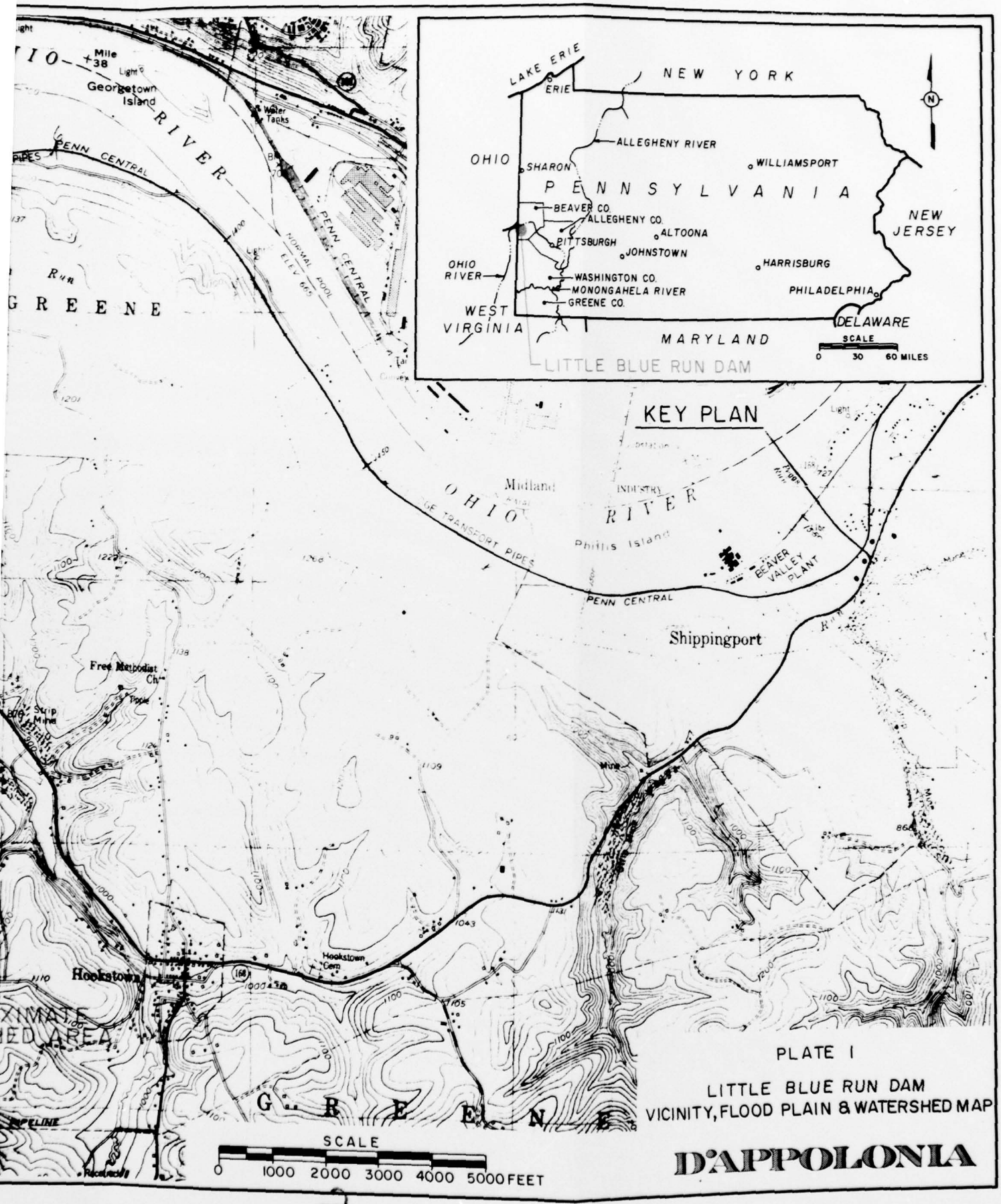
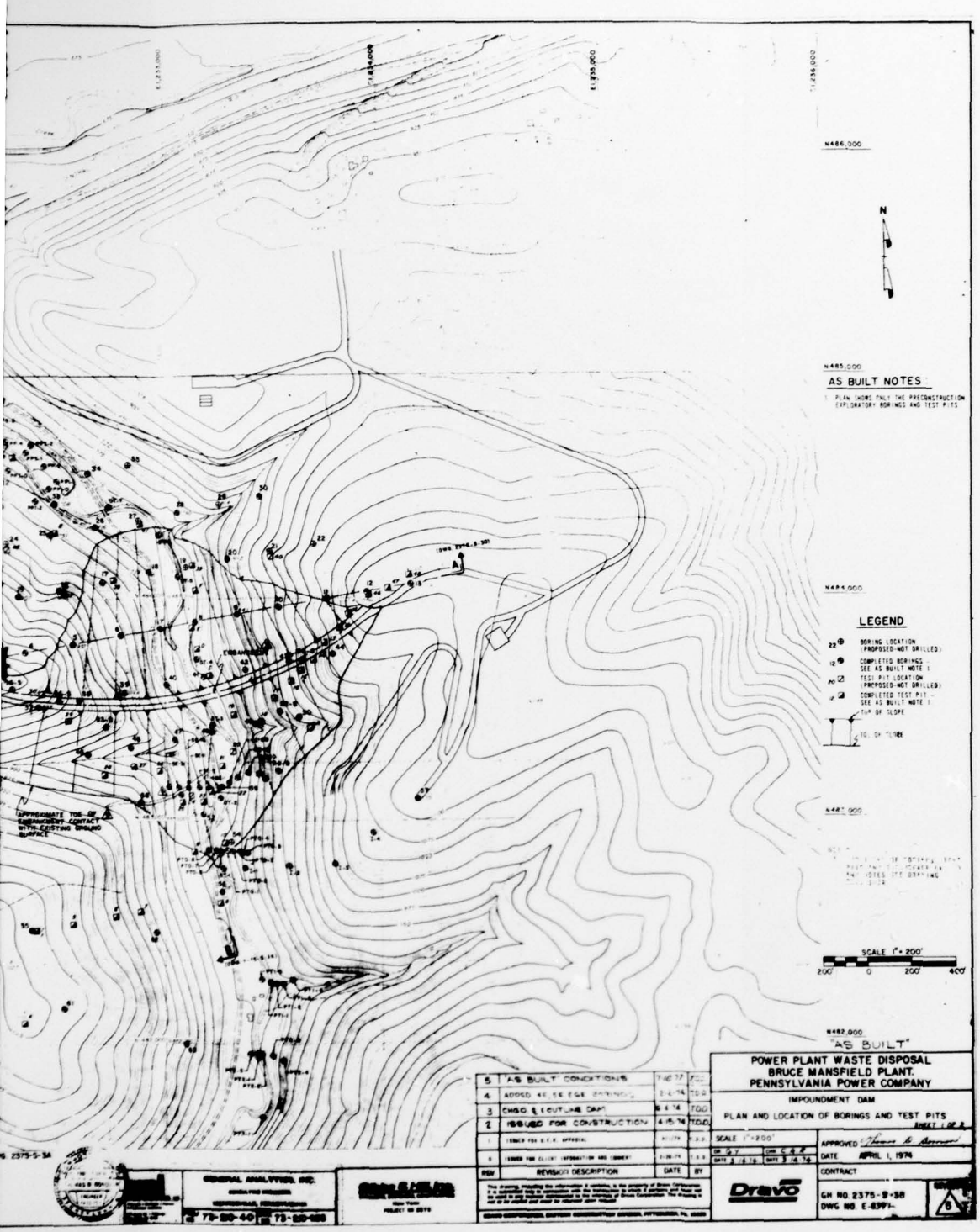


PLATE I

LITTLE BLUE RUN DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	RG	7-24-79	DRAWING NUMBER	78-367-B145
	6-13-79	APPROVED BY	JHP	7/29/79		



REV	REVISION DESCRIPTION	DATE	BY
5	AS BUILT CONDITIONS	7/16/77	TDD
4	ADDED 45' TOE EDGE BORINGS	2-6-76	TDD
3	CHGD. & EXTENDED DAM	8-6-74	TDD
2	ISSUED FOR CONSTRUCTION	6-15-74	TDD
1	ISSUED FOR D.E.R. APPROVAL	4-12-74	T.D.D.
0	ISSUED FOR CLIENT INFORMATION AND COMMENT	2-28-74	T.D.D.

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM

PLAN AND LOCATION OF BORINGS AND TEST PITS

SHEET 1 OF 2

SCALE 1"=200'
DR. G.A.Y.
CHK. C.G.P.
DATE 3-14-74
APPROVED
DATE APRIL 1, 1974
CONTRACT
GH NO. 2375-9-38
DWG NO. E-8391-

Dravo

GENERAL ANALYTICS INC.

79-20-40 79-20-100

GAI PROJECT NO. 2375

PLATE 2

2

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	JSE	7-24-79	DRAWING NUMBER	78-367-B146
	6-13-79	APPROVED BY	JWD	7/24/79		

2875-S-98

AS BUILT NOTES:

1. THE EMBANKMENT WAS NOT CONSTRUCT... IN THE PROPOSED PHASES SHOWN ON T... DRAWING. CONSTRUCTION OCCURRED ... OR LESS CONTINUOUSLY TO ELEVATION ... EXCEPT FOR A MUCH SHUTDOWN DU... DUE TO EXTREME WINTER WEATHER ... CONDITIONS. THE ACTUAL CONFIG... OF THE EMBANKMENT AT ELEV. 900 ... ELEV. 1000 AND WHERE THE MAIN ... SHUTDOWN PERIOD IS SHOWN ON TH...

2. PARTIAL UPSTREAM BARRIER CONSTR... BY SEALING BEDROCK WITH DENTAL ... CONCRETE AND CLAY AS DETERMIN...

3. FOLLOWING THE SHUTDOWN PERIOD, ... MATERIAL WAS REMOVED FROM THE ... OF THE EMBANKMENT, ZONE I WAS ... TO SUITABLE MATERIALS AND FIELD ... TESTS WERE PERFORMED PRIOR TO ... RESUMPTION OF EMBANKMENT CON...

CAMBER DIAGRAM
SCALE: NONE

ELEV. 1100

22+00 20+00 18+00 16+00 14+00 12+00 10+00 8+00 6+00 4+00 2+00 1+00

ELEVATION

EMBANKMENT CREST EL. 1100 SEE DETAIL C

PROPOSED PHASE 2 EMBANKMENT CREST EL. 1000 (SEE AS BUILT NOTE 1)

ACT. AL CONFIGURATION OF EMBANKMENT AT CREST ELEV. 1000

ACT. AL CONFIGURATION OF EMBANKMENT AT CREST ELEV. 900

PROPOSED FIRST YEAR EMBANKMENT CREST EL. 900 SEE AS BUILT NOTE 1

EL. 900

DETAIL E

DETAIL H

RANDOM ROCK MATERIAL ZONE 2

RESISTANT SANDSTONE MATERIAL ZONE 3

NON-RESISTANT ROCK TRANSITION MATERIAL ZONE 4

IMPERVIOUS CORE MATERIAL ZONE 1

FILTERS

APPROXIMATE TOP OF ROCK

UPSTREAM SEEPAGE BARRIER AREA

CORE TRENCH EXCAVATED TO TOP OF COMPETENT ROCK

FILTER BLANKET SEE DETAIL ... OF FILTER ... OF FILTER

TYPICAL DESIGN SECTION
SCALE: 1" = 50'

SCALE 1" = 50'
50' 0 50' 100'

RESISTANT SANDSTONE

NON-RESISTANT ROCK TRANSITION

IMPERVIOUS CORE

4.25 4.25

EL. 1000

FILTER C1

FILTER C2

RANDOM ROCK

DETAIL "E"
SCALE: 1"=10'

DETAIL "H"
SCALE: 1"=10'

RANDOM ROCK

EL. 900

FILTER C1

FILTER C2

TOP OF ROCK

DETAIL "G"
SCALE: 1"=10'

GENERAL ANALYTICS, INC.
CONSULTING ENGINEERS
MONROEVILLE, PA.

PROJ. NO. 73-210 DWG. NO. 73-210-M29

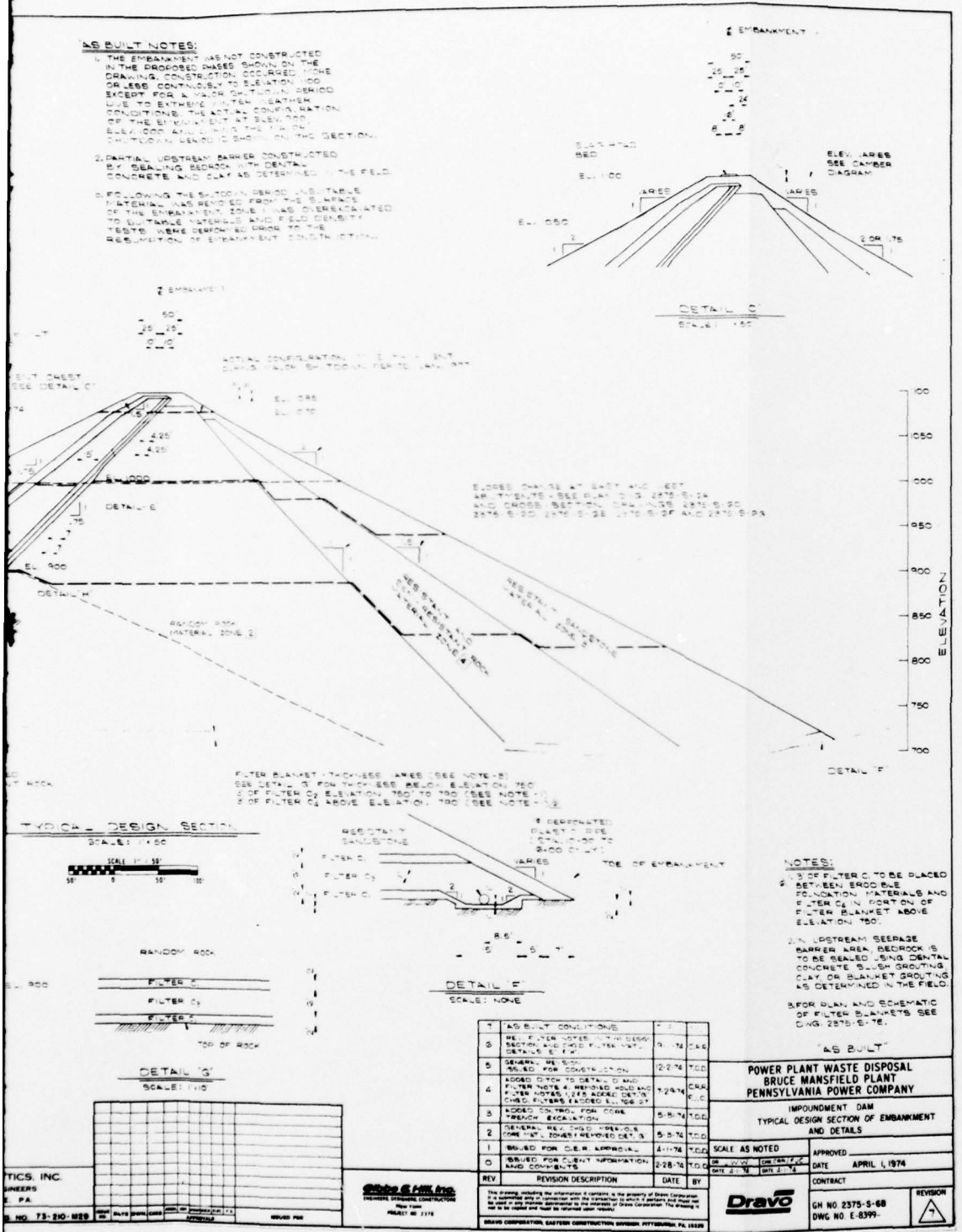
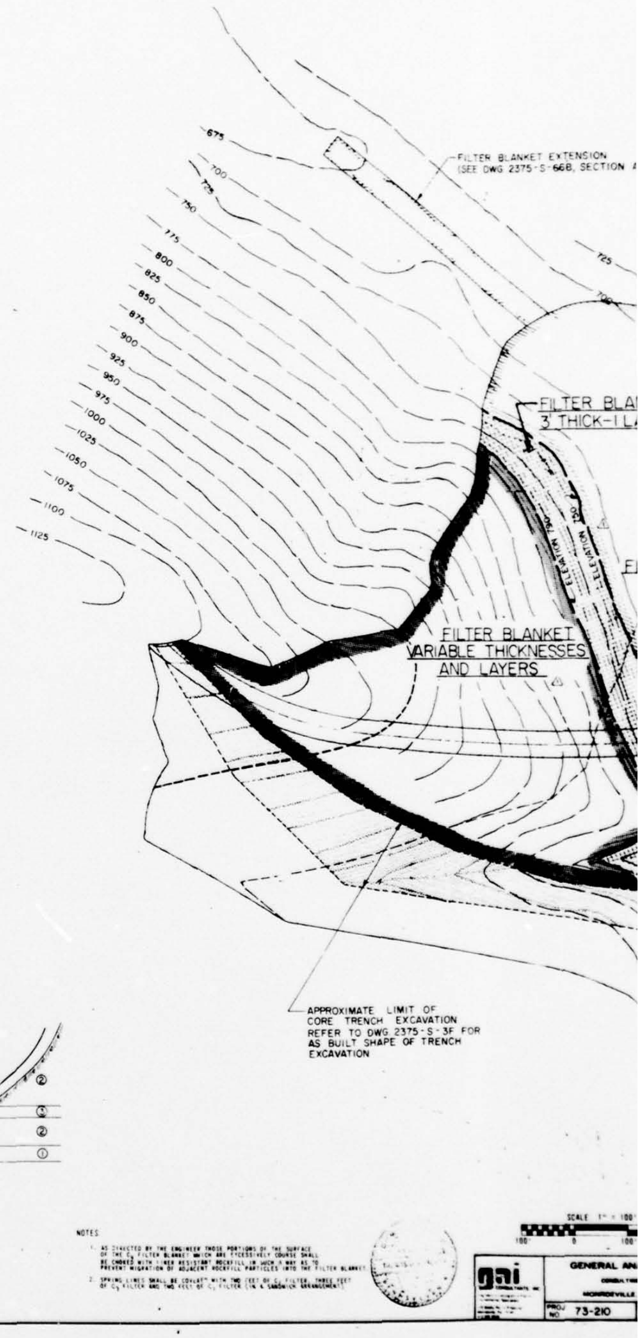


PLATE 3

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	[illegible]	7-24-79	DRAWING NUMBER	78-367-B147
	6-13-79	APPROVED BY	[illegible]	7/24/79		

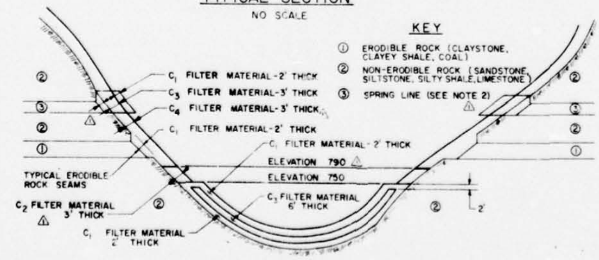
2375-S-7E



AS BUILT NOTES:

1. THE EMBANKMENT WAS NOT CONSTRUCTED IN THE PROPOSED PHASES SHOWN ON THE DRAWING. CONSTRUCTION OCCURRED MORE OR LESS CONTINUOUSLY TO ELEVATION 1100 EXCEPT FOR A MAJOR SHUTDOWN PERIOD DUE TO EXTREME WINTER WEATHER CONDITIONS. THE ACTUAL CONFIGURATION OF THE EMBANKMENT AT ELEVATION 900, ELEVATION 1000 AND DURING THE SHUTDOWN PERIOD IS SHOWN ON THE TYPICAL DESIGN SECTION - DWG. 2375-S-6B.
2. TOP OF ROCK CONTOURS AS SHOWN WERE APPROXIMATED PRIOR TO CONSTRUCTION. SEE DRAWING FOR SURVEYED TOP OF ROCK CONTOURS.

SCHEMATIC OF FILTER BLANKETS
TYPICAL SECTION
NO SCALE



KEY

① ERODIBLE ROCK (CLAYSTONE, CLAYEY SHALE, COAL)
② NON-ERODIBLE ROCK (SANDSTONE, SILTSTONE, SILTY SHALE, LIMESTONE)
③ SPRING LINE (SEE NOTE 2)

NOTES:

1. AS DIRECTED BY THE ENGINEER THOSE PORTIONS OF THE SURFACE OF THE C_3 FILTER BLANKET WHICH ARE EXCESSIVELY COURSE SHALL BE CHOKED WITH FINER RESISTANT ROCKFILL IN SUCH A WAY AS TO PREVENT MIGRATION OF ADJACENT ROCKFILL PARTICLES INTO THE FILTER BLANKET.
2. SPRING LINES SHALL BE COVERED WITH TWO FEET OF C_1 FILTER, THREE FEET OF C_3 FILTER AND TWO FEET OF C_1 FILTER (IN A SANDWICH ARRANGEMENT).

SCALE 1" = 100'

gai

GENERAL AN[...]

PROJ NO. 73-210

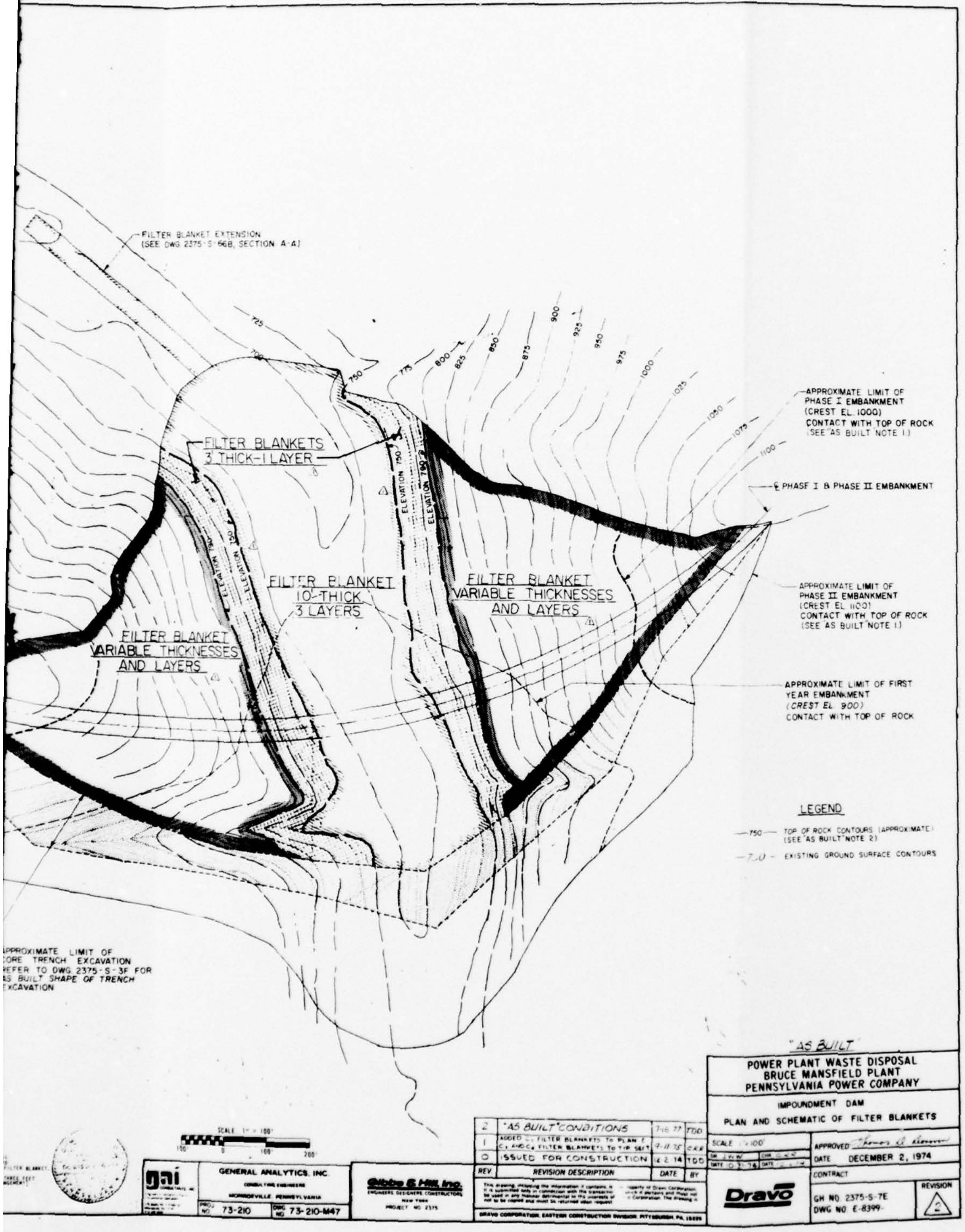


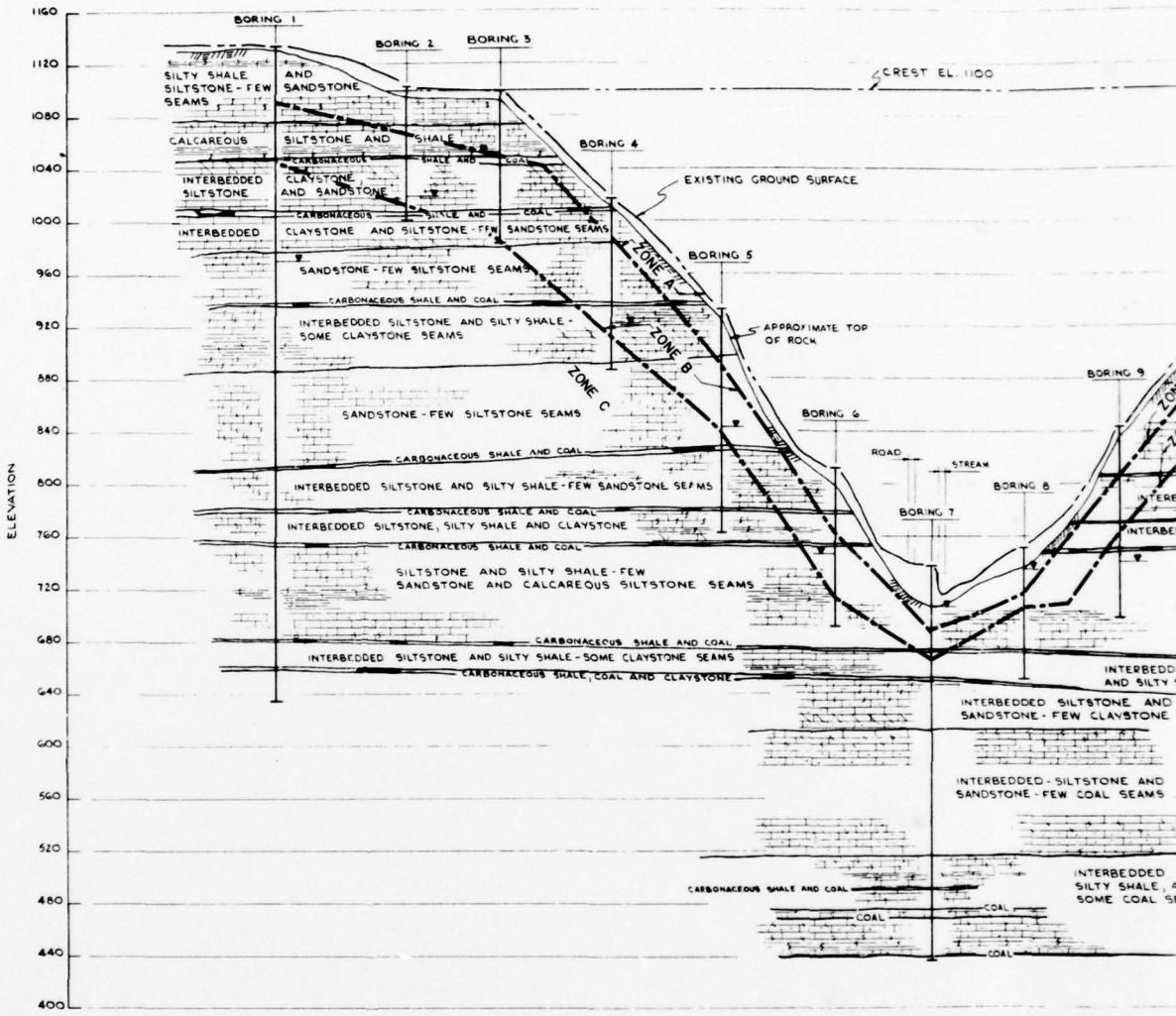
PLATE 4

D'APPOLONIA

2

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER	78-067-B148
	6-13-79	APPROVED BY	JMP 7/24/79		

2575-B-30



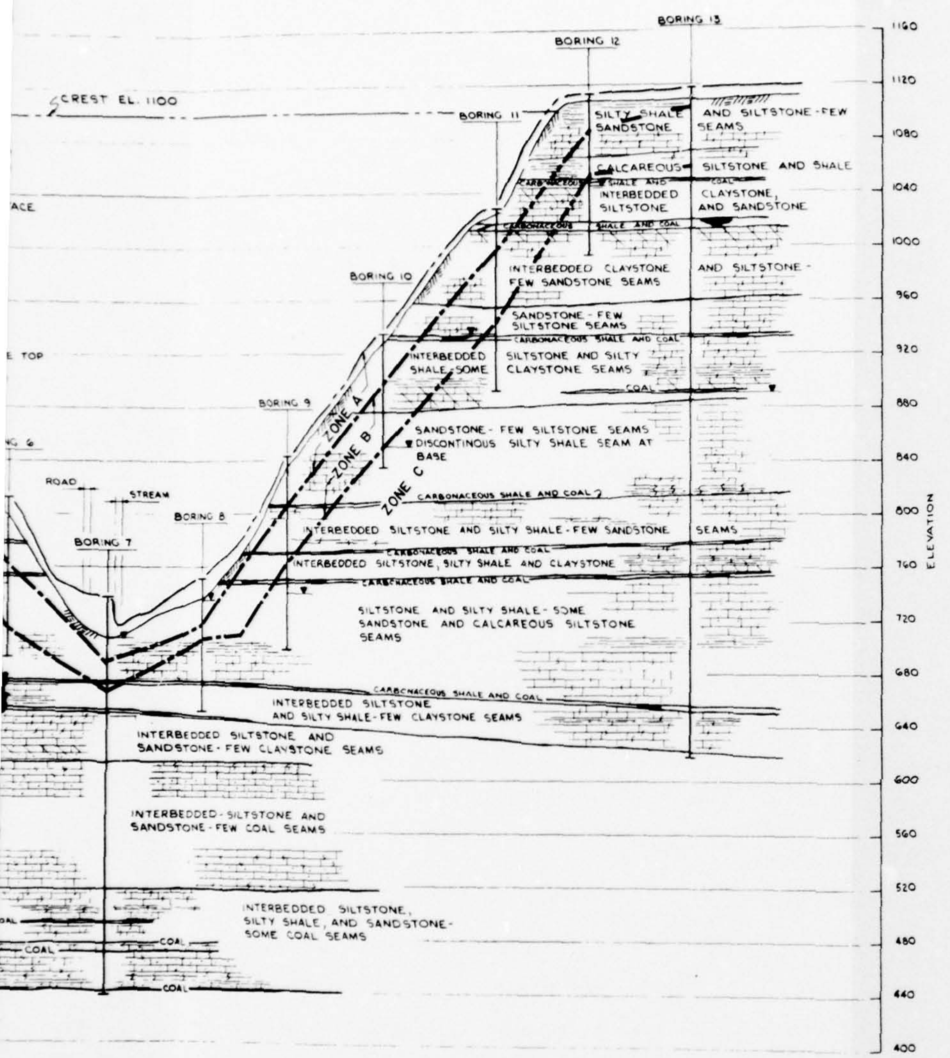
SECTION A-A

NOTES:
1. FOR PLAN AND L... AND SECTION S...
2. FOR LEGEND AN... SEE DRAWING 2...

GENERAL ANALYTICS...

JOB NO. 73-210

1



SECTION A-A

GENERALIZED ZONES OF PERMEABILITY

ZONE A = 1×10^{-3} CENTIMETERS/SECOND

ZONE B = 1×10^{-4} CENTIMETERS/SECOND

ZONE C = 1×10^{-5} CENTIMETERS/SECOND OR LESS

HORIZONTAL SCALE: 1" = 100'

100' 0 100' 200'

VERTICAL SCALE: 1" = 40'

40' 0 40' 80'

"AS BUILT"

NOTES:

1. FOR PLAN AND LOCATION OF BORINGS AND SECTION SEE DRAWING 2375-S-3B.
2. FOR LEGEND AND SUBSURFACE NOTES SEE DRAWING 2375-S-3A.

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
GENERALIZED GEOLOGIC CROSS SECTION
SECTION A-A

REV.	REVISION DESCRIPTION	DATE	BY
3	"AS BUILT" CONDITIONS	7-18-77	TDD
2	ISSUED FOR CONSTRUCTION	4-15-74	T.D.D.
1	ISSUED FOR D.E.R. APPROVAL	4/1/74	T.D.D.
0	ISSUED FOR CLIENT INFORMATION AND COMMENT	3-25-74	T.D.D.

SCALE AS SHOWN
DR C.Y. CHK C.R.R.
DATE 11-1-73 DATE 3-14-74
APPROVED [signature]
DATE APRIL 1, 1974
CONTRACT
GH NO. 2375-S-3D
DWG NO. E-8399-
REVISION 3

Dravo

GENERAL ANALYTICS, INC.
CONSULTING ENGINEERS
MONROEVILLE, PENNSYLVANIA
PROJ NO 73-210
DWG NO 73-210-M14

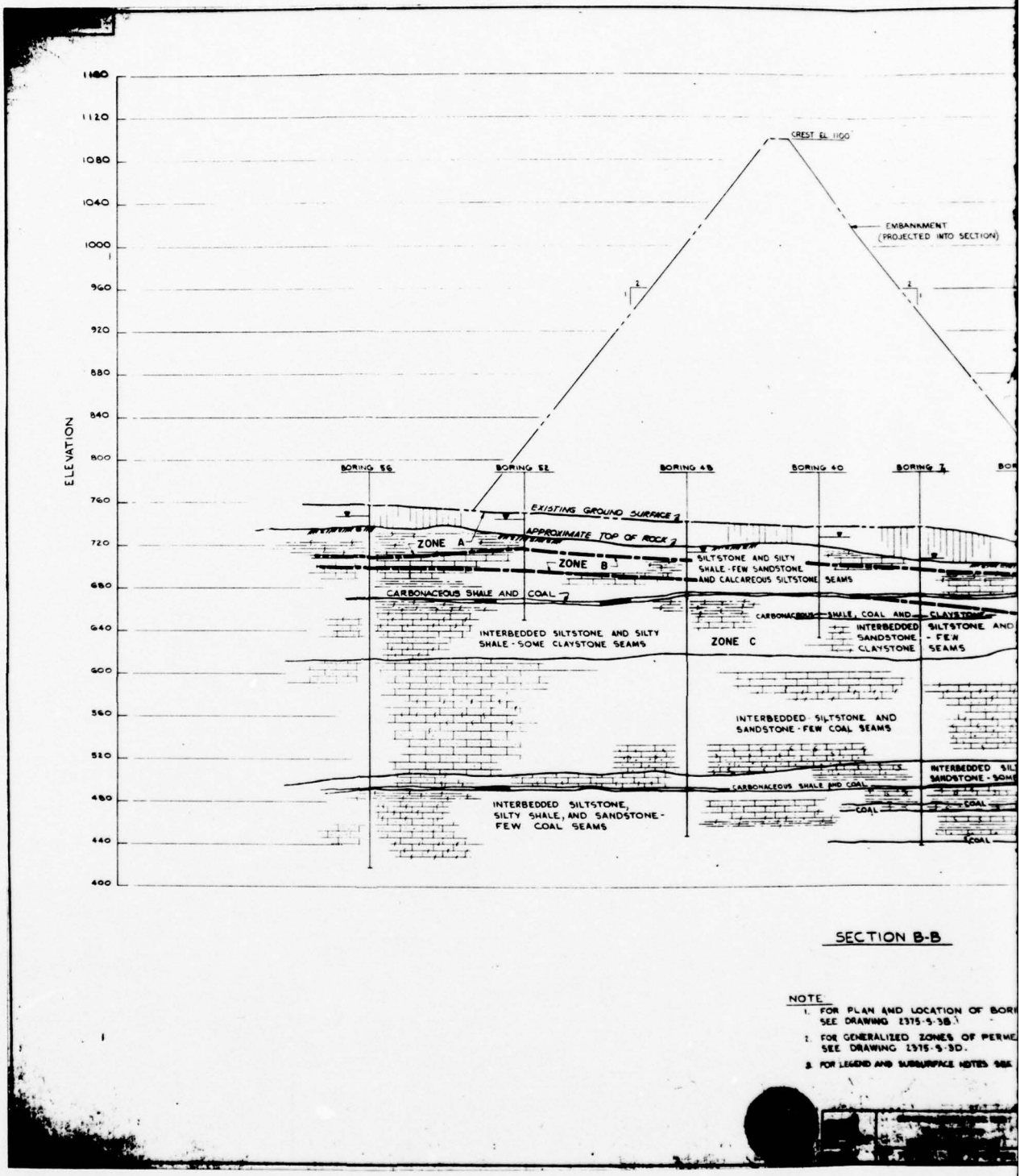
Gibbs & Hill, Inc.
NEW YORK
PROJECT NO 8975

PLATE 5

D'APPOLONIA

2

DRAWN BY	ACS	CHECKED BY	ISE	7-24-79	DRAWING NUMBER	7t 37-B149
	6-13-79	APPROVED BY	JHD	7/24/79		

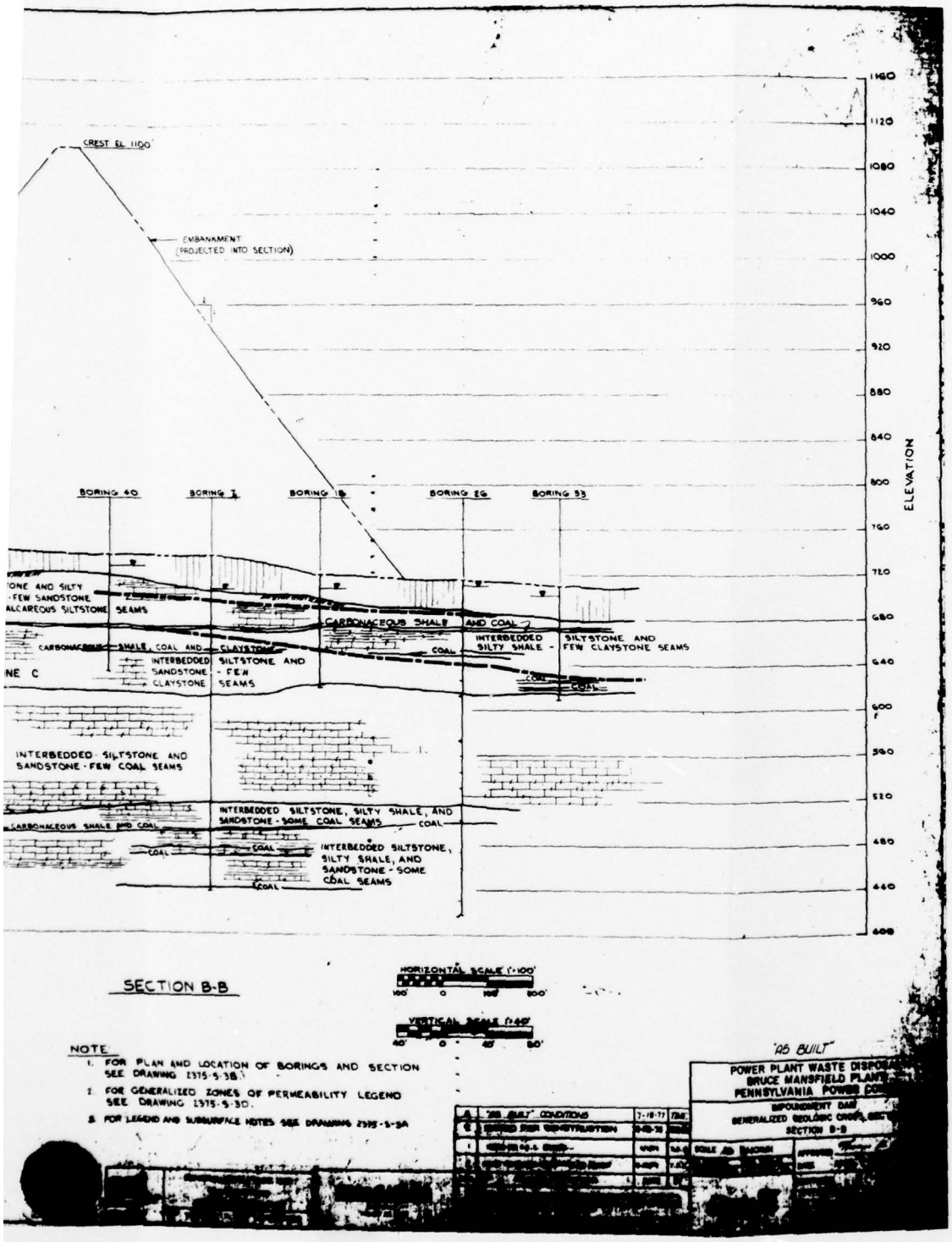


SECTION B-B

NOTE

1. FOR PLAN AND LOCATION OF BORI SEE DRAWING E375-S-3B.
2. FOR GENERALIZED ZONES OF PERME SEE DRAWING E375-S-3D.
3. FOR LEGEND AND SUBSURFACE NOTES SEE

1



SECTION B-B

NOTE

1. FOR PLAN AND LOCATION OF BORINGS AND SECTION SEE DRAWING 2375-5-3B.
2. FOR GENERALIZED ZONES OF PERMEABILITY LEGEND SEE DRAWING 2375-5-3D.
3. FOR LEGEND AND SUBSURFACE NOTES SEE DRAWING 2375-5-3A

"AS BUILT"

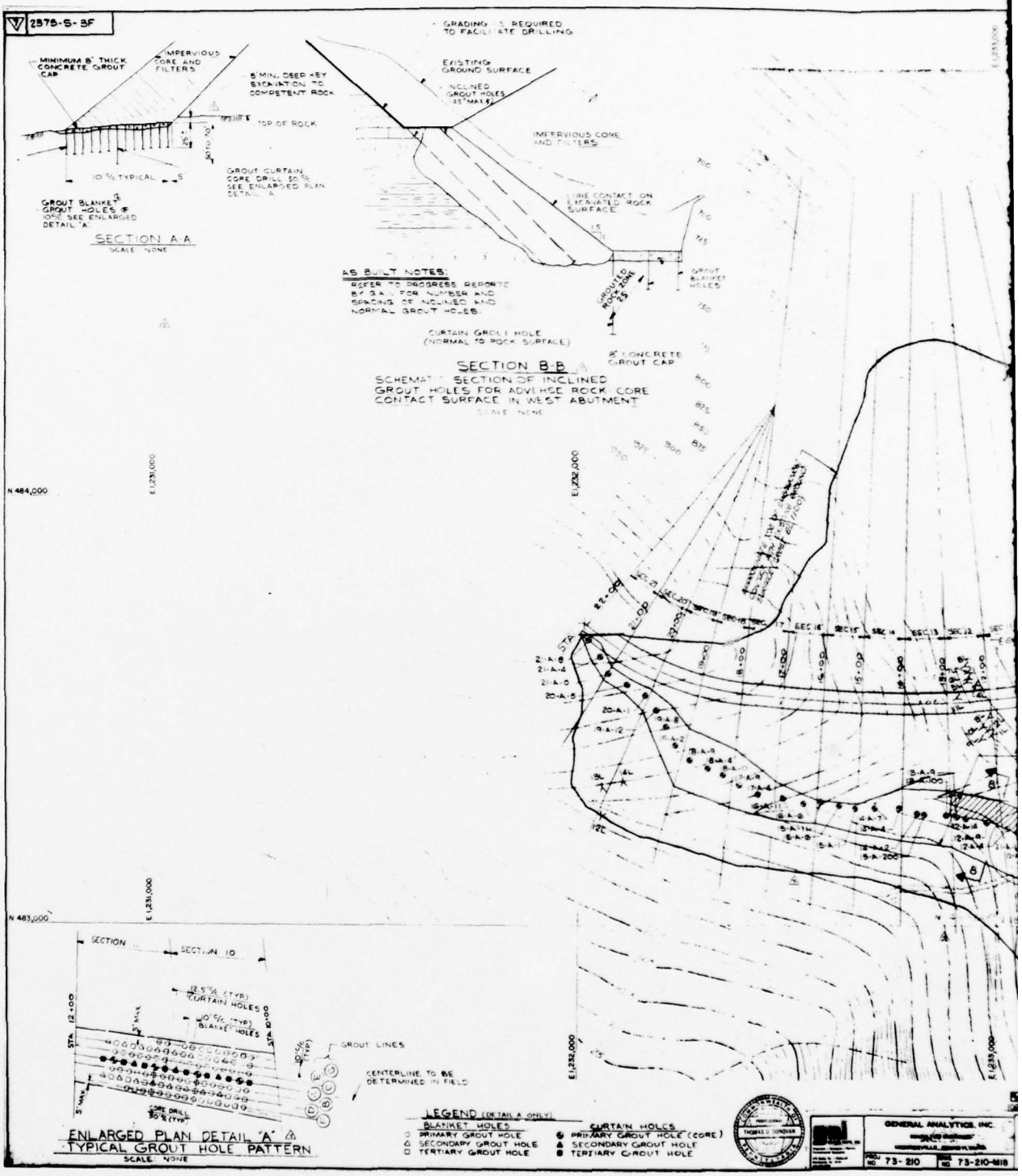
POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER CO.
IMPOUNDMENT DAM
GENERALIZED GEOLOGIC CROSS SECTION B-B

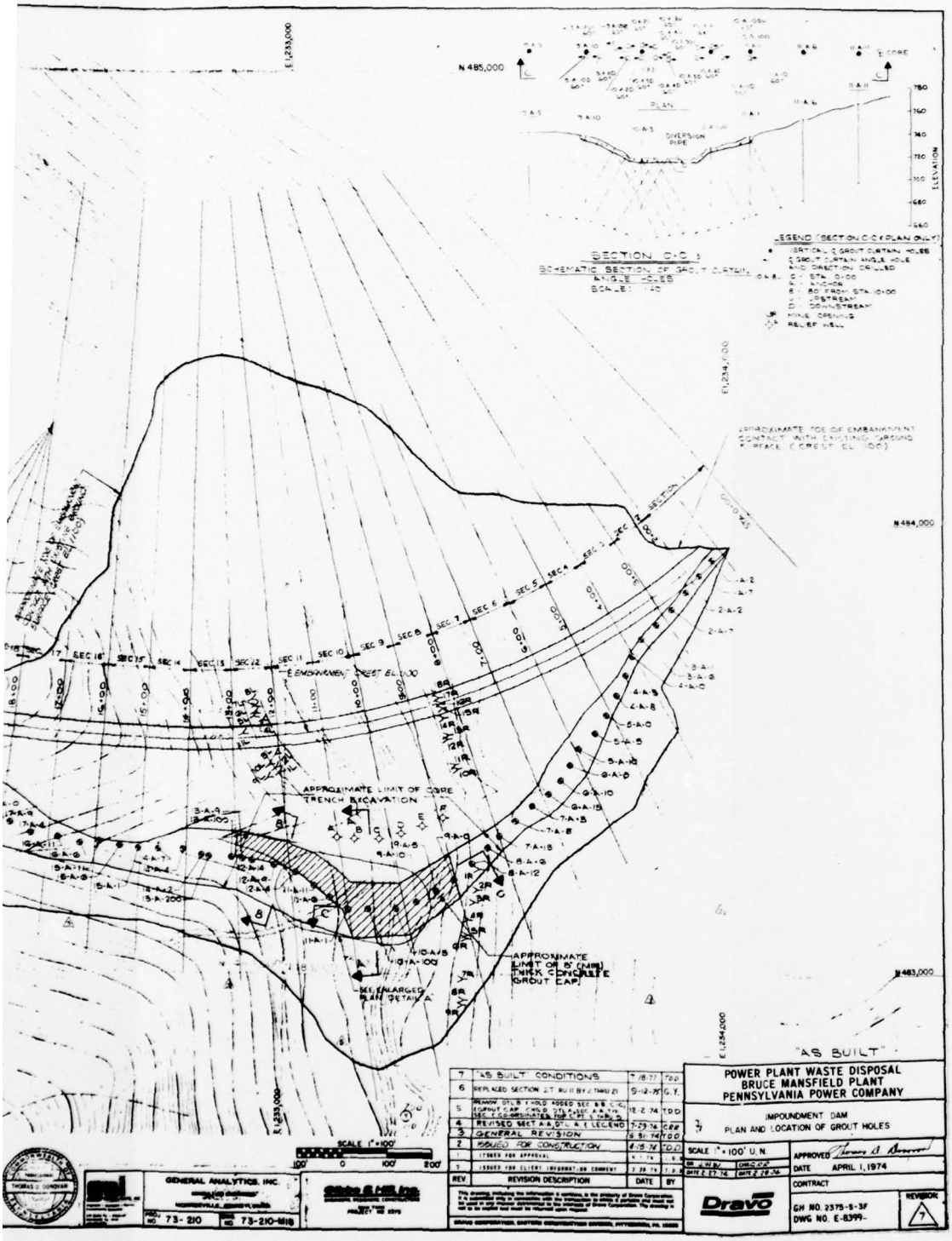
PLATE 6

2

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY		2-24-79	DRAWING NUMBER	67-B150
	6-13-79	APPROVED BY		7/20/79		





REV	REVISION DESCRIPTION	DATE	BY
7	"AS BUILT" CONDITIONS	7-18-77	TDD
6	REPLACED SECTION 27 BUILT BY 2 THRU 21	5-12-75	G.Y.
5	REMOVED STA. 8+HOLD ADDED SEC. B-B (C-C) (GROUT CAP) HOLD STA. 9+ADD A-A, C-C, SEC. 1 & 2 CONSOLIDATED & TOP C PT. 3 THRU 21	12-2-74	TDD
4	REVISED SECT. A-A, D-D, & LEGEND	7-29-74	CDD
3	GENERAL REVISION	5-31-74	TDD
2	ISSUED FOR CONSTRUCTION	4-15-74	TDD
1	ISSUED FOR APPROVAL	4-1-74	T.D.D.
	ISSUED FOR CLIENT INFORMATION COMMENT	3-29-74	T.D.D.

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
PLAN AND LOCATION OF GROUT HOLES

SCALE 1" = 100' U.S.

DR. J.W.D. CHKD. C.D. DATE 2-27-74 DATE 2-28-74

APPROVED Thomas D. Donovan
DATE APRIL 1, 1974
CONTRACT
GH NO. 2375-S-3F
DWG NO. E-8399-
REVISION 7

GENERAL ANALYTICS, INC.
PROJ. NO. 73-210
NO. 73-210-6618

Gibbs & Hill, Inc.

Dravo

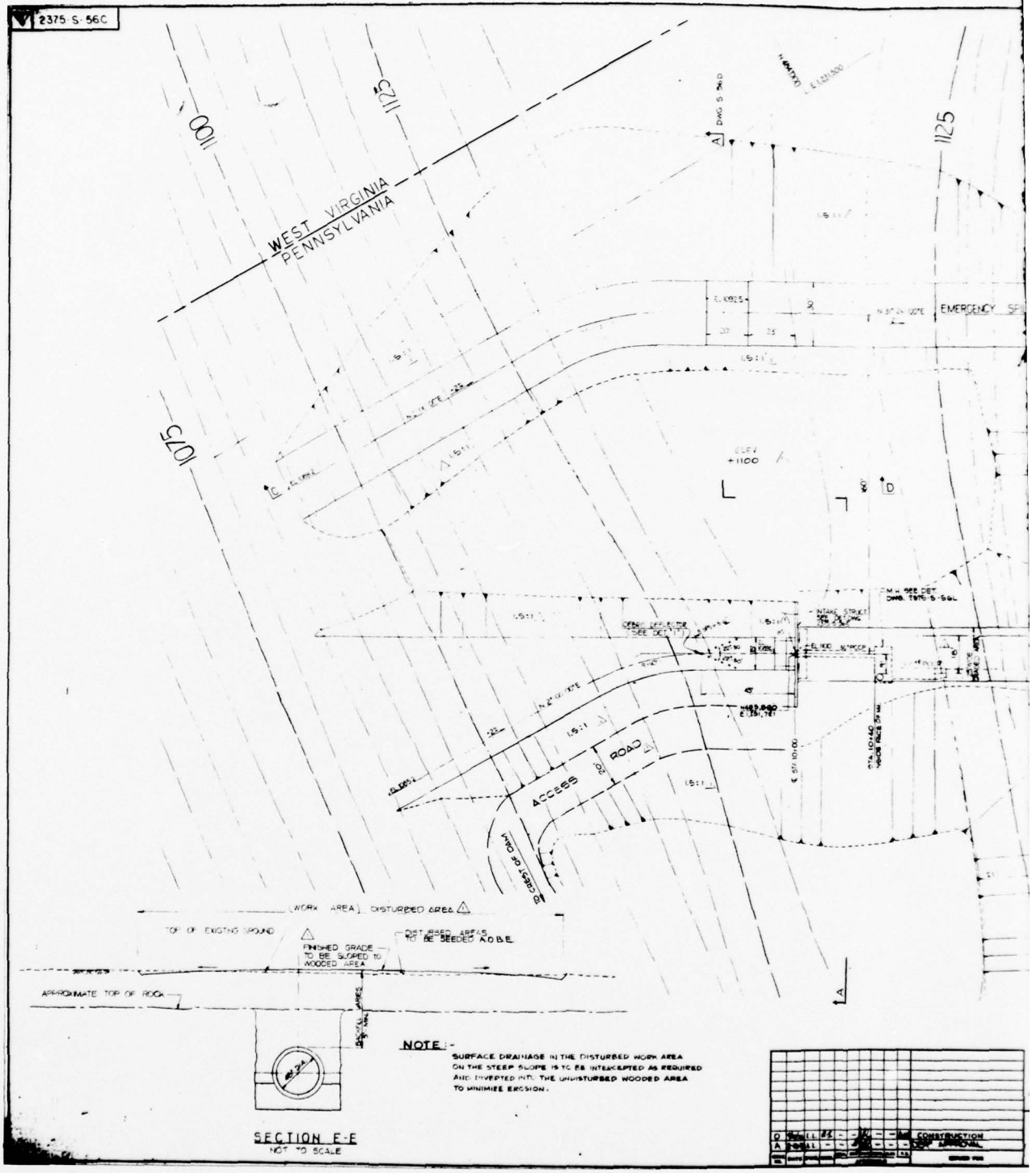
PLATE 7

2

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY		12-24-79	DRAWING NUMBER 78-37-B151
	6-13-79	APPROVED BY		12/24/79	

2375-S-56C



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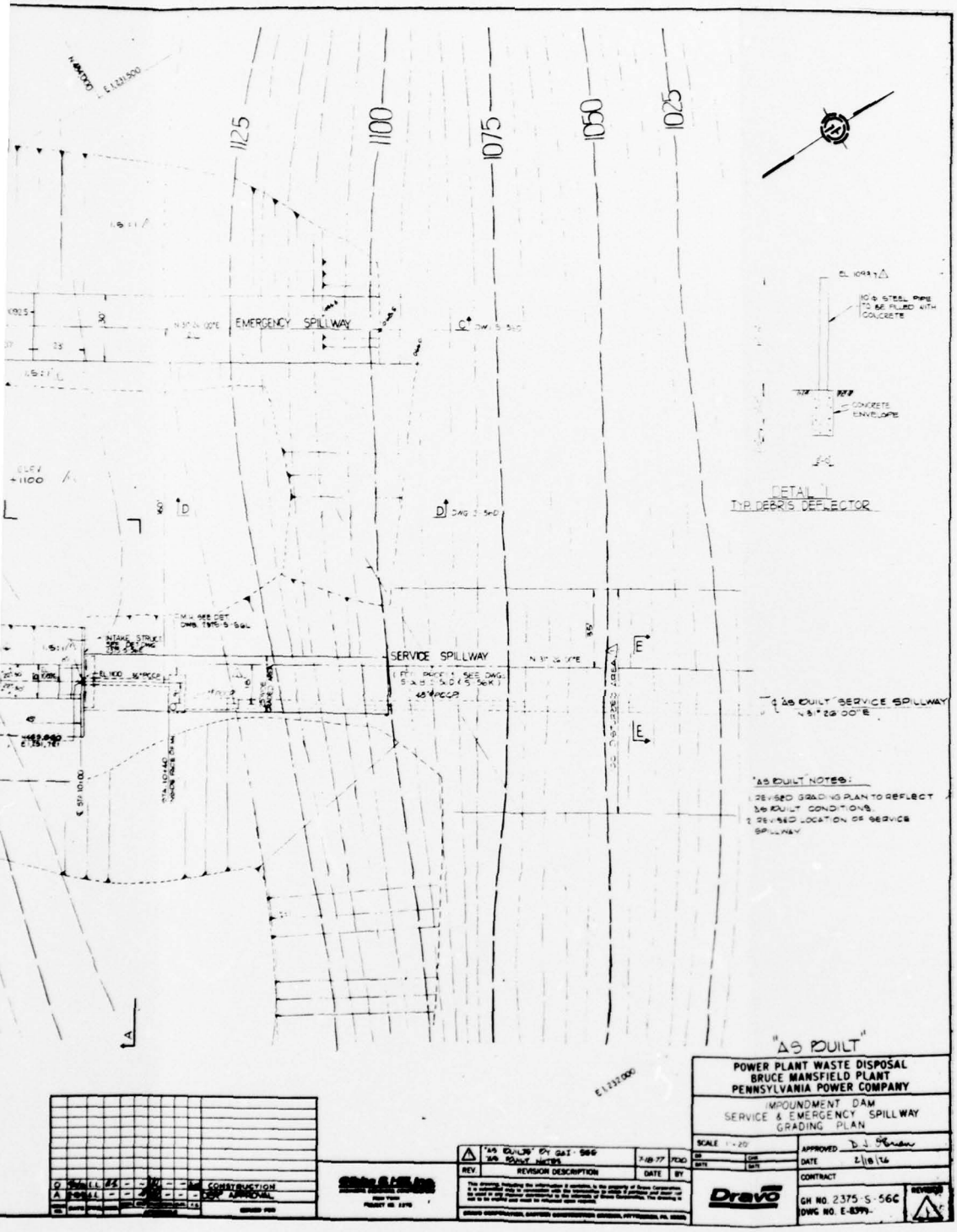


"AS BUILT"

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
SERVICE & EMERGENCY SPILLWAY
GRADING PLAN

SCALE 1" = 20'
APPROVED D. J. O'Brien
DATE 2/18/76
CONTRACT
GH NO. 2375-S-56C
DWG NO. E-8399-

REV. REVISION DESCRIPTION — DATE — BY
"AS BUILT" BY GAI - SBG
AS BUILT NOTES — 7-19-77 — TCD

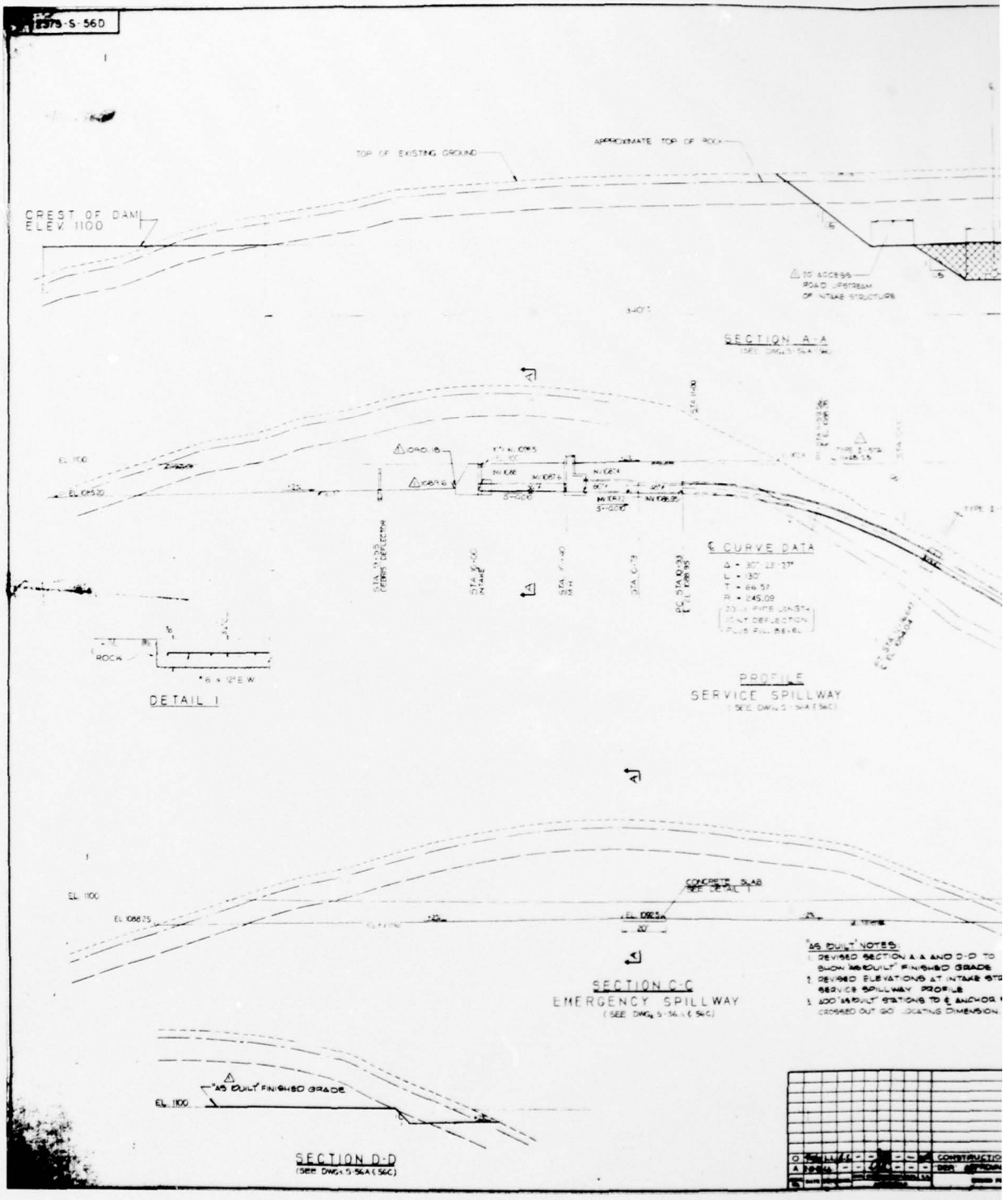
Dravo

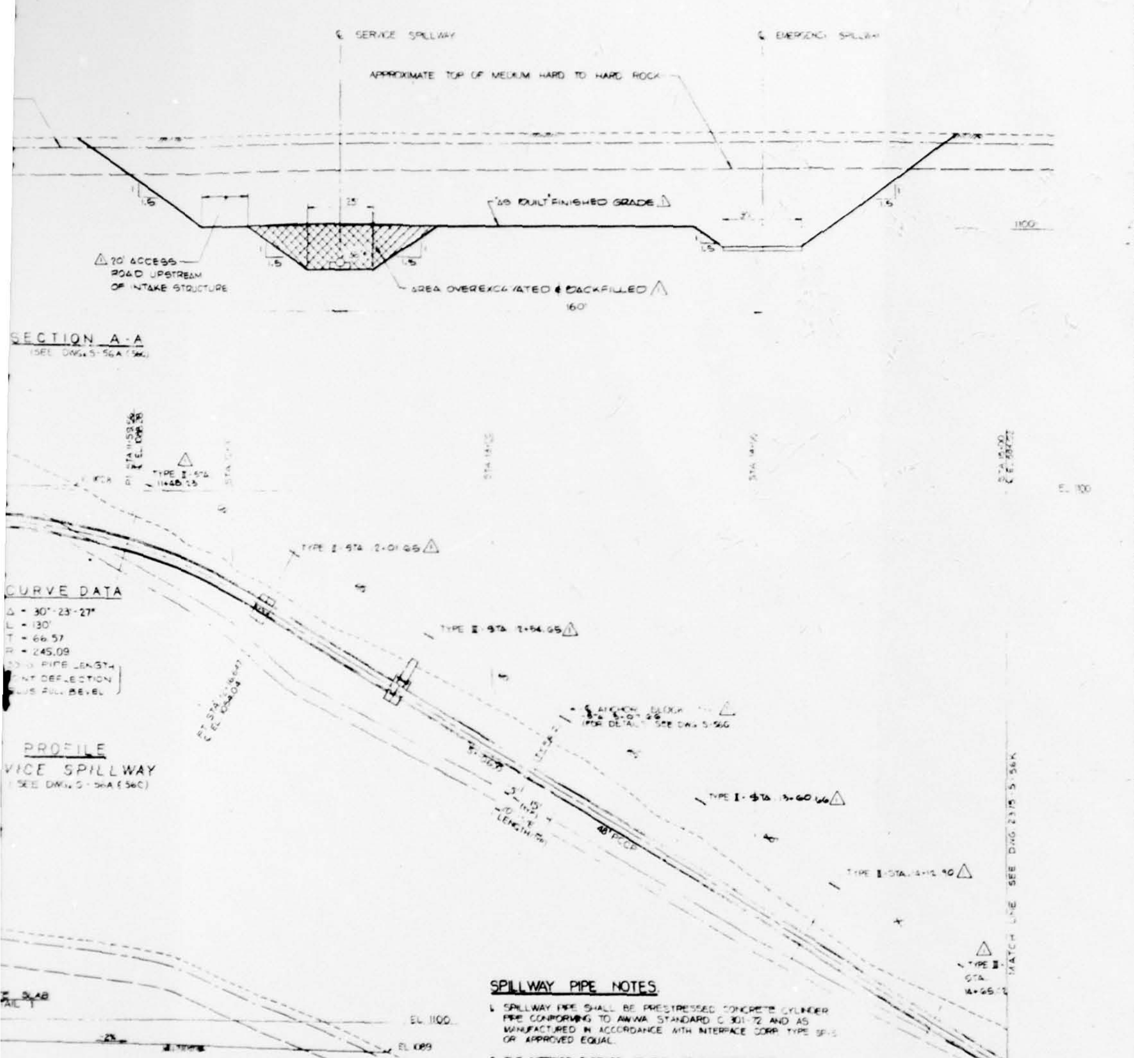
PLATE 8

2

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	MC	7-24-79	DRAWING NUMBER 76-67-B152
	6-13-79	APPROVED BY	JMD	7/26/79	





"AS BUILT" NOTES:

1. REVISED SECTION A-A AND D-D TO SHOW "AS BUILT" FINISHED GRADE
2. REVISED ELEVATIONS AT INTAKE STRUCTURE, SERVICE SPILLWAY PROFILE
3. ADD "AS BUILT" STATIONS TO ℄ ANCHOR BLOCKS. CROSSED OUT 60' LOCATING DIMENSION.

SPILLWAY PIPE NOTES:

1. SPILLWAY PIPE SHALL BE PRESTRESSED CONCRETE CYLINDER PIPE CONFORMING TO AWWA STANDARD C 301-72 AND AS MANUFACTURED IN ACCORDANCE WITH INTERPACE CORP. TYPE SP-5 OR APPROVED EQUAL.
2. THE INTERIOR SURFACE OF THE 48" DIAMETER PIPE SHALL BE COATED PRIOR TO INSTALLATION WITH AN EPOXY COATING SUCH AS "HI-BILD" AS MANUFACTURED BY SIKA CHEMICAL CORP. OR APPROVED EQUAL.
3. AFTER INSTALLATION, THE PIPE JOINTS SHALL BE FILLED WITH AN EPOXY MORTAR PREPARED BY USING "LO-MOD" ADHESIVE AS MANUFACTURED BY SIKA CHEMICAL CORP. OR APPROVED EQUAL.

"AS BUILT"

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
SERVICE & EMERGENCY SPILLWAY SECTIONS AND PIPE PROFILE

SCALE 1" = 20'
APPROVED D. J. O'Brien
DATE 2/18/76
CONTRACT

Dravo

GH NO. 2375-S-560
DWG NO. E-8399

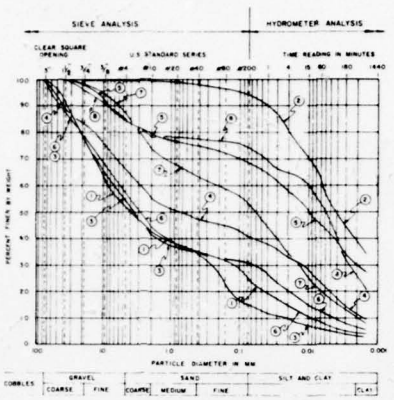
REV 1 — "AS BUILTS" BY BAI - GEB "AS BUILT" NOTES — 7/18/77

PLATE 9

D'APPOLONIA

2

DRAWN BY	ACS	CHECKED BY	BE	7-24-79	DRAWING NUMBER 76 J67-B153
	6-13-79	APPROVED BY	JMD	7/24/79	

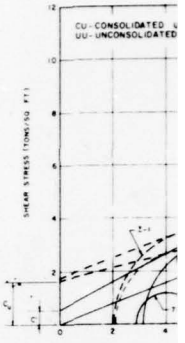


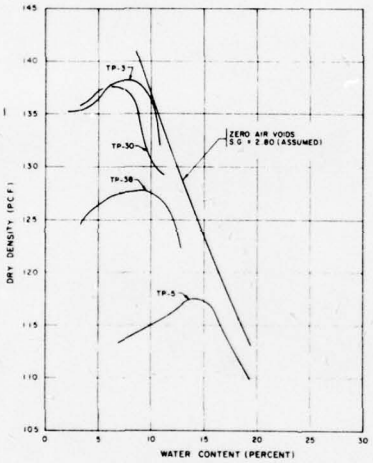
GRAIN SIZE DISTRIBUTION CURVES
POTENTIAL CORE MATERIALS
FIGURE I

INDEX OF GRAIN SIZE CURVES

CURVE NO.	TEST PIT NO.	DEPTH OF SAMPLE	GROUP DESIGNATION
①	4	1.0 - 4.0	A_1
②	5	3.0 - 8.0	B_1
③	8	0.0 - 9.0	—
④	12	1.0 - 5.5	A_1
⑤	17	2.0 - 6.0	B_1
⑥	18	5.0 - 10.0	A_1
⑦	30	3.0 - 9.0	A_2
⑧	38	3.0 - 10.0	B_2

*FOR TEST PIT LOCATIONS SEE DRAWINGS 2375-S-38 AND 2375-S-3C





MOISTURE - DENSITY RELATIONSHIPS
ON CORE MATERIALS
(A.S.T.M. D1557-70)
FIGURE II

GROUP DESIGNATION	TEST PIT NUMBER	TEST TYPE	SAMPLE NUMBER	MODIFIED PROCTOR MAXIMUM γ_D P.C.F.	MODIFIED PROCTOR OPTIMUM W.C. %	TRIAXIAL CONSOLIDATION PRESSURE TSF	TESTED γ_D P.C.F.	TESTED W.C. %	PERMEABILITY CM./SEC.	STRENGTH PARAMETERS ϕ OR ϕ_u DEGREES	STRENGTH PARAMETERS C OR C_u TSF
A_1	3	PERMEABILITY (CONSTANT HEAD)	1	138.2	8.0	—	132.1	10.8	1×10^{-4}	—	—
	3	CONSOLIDATION	2	138.2	8.0	—	119.6	10.6	—	—	—
	3	TRIAXIAL UNCONSOLIDATED UNDRAINED	3-1	138.2	8.0	2.1	125.5	11.1	—	ϕ_u 21.0	C_u 1.70
			3-2			5.2	126.1	11.1			
			3-3			10.5	127.0	11.1			
	3	TRIAXIAL CONSOLIDATED UNDRAINED	4-1	138.2	8.0	2.1	128.2	9.5	—	ϕ 27.1	C 0.56
			4-2			5.2	129.0	9.5			
			4-3			10.3	129.4	9.5			
B_2	38	PERMEABILITY (CONSTANT HEAD)	5	127.8	9.0	—	122.3	12.9	2×10^{-4}	—	—
	38	CONSOLIDATION	6	127.8	9.0	—	124.7	13.6	—	—	—
	38	TRIAXIAL UNCONSOLIDATED UNDRAINED	6-1	127.8	9.0	2.1	122.5	12.5	—	ϕ_u 13.5	C_u 1.60
			6-2			5.2	120.9	12.5			
			6-3			10.5	123.1	12.5			
	38	TRIAXIAL CONSOLIDATED UNDRAINED	7-1	127.8	9.0	2.1	120.8	12.6	—	ϕ 21.3	C 0.00
			7-2			5.2	123.6	12.6			
			7-3			10.3	123.1	12.6			
B_1	5	PERMEABILITY	8	117.5	14.0	—	115.3	16.3	$<1 \times 10^{-5}$	—	—
A_2	30	PERMEABILITY	9	137.5	6.5	—	134.8	8.2	4×10^{-5}	—	—
DESIGN VALUES USED			—	—	—	—	125.0	12.0	1×10^{-4}	ϕ_u = 13.5 ϕ = 24.2	C_u = 1.60 C = 0.28

TABLE III
LABORATORY TEST DATA ON CORE MATERIALS

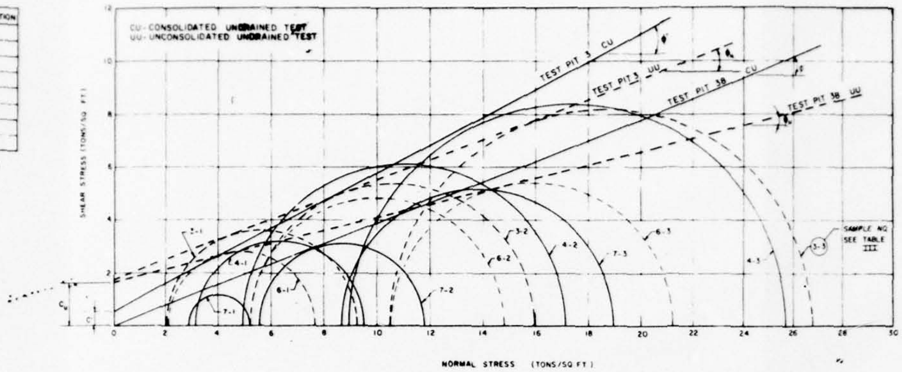
NOTES:
1. FOR PLAN AND LOCATION OF TEST PITS REFER TO DRAWINGS 2375-S-38 AND 2375-S-3C.
2. ADDITIONAL LABORATORY TEST DATA FROM SOIL SAMPLES RECOVERED FROM BORING HOLE "D" ARE PRESENTED IN SECTION VIII-A OF ADDENDUM 4 TO THE APPLICATION FOR DAM CONSTRUCTION.

γ_D =
wC =
ϕ =
ϕ_u =
C =
C_u =
C_r =
ϕ_r =
LL =
PL =
PI =
SG =
TP =

SIZE CURVES

... OF SAMPLE	GROUP DESIGNATION
...0' - 4.0'	A_1
...0' - 5.0'	B_1
...0' - [illegible]	—
...0' - 5.5'	A_1
...0' - 6.0'	B_1
...0' - 10.0'	A_1
...0' - 9.0'	A_2
...0' - 10.0'	B_2

...EE DRAWINGS 2375-S-38



MOHR - COULOMB FAILURE ENVELOPES (EFFECTIVE STRESSES)

TRIAXIAL TEST DATA ON CORE MATERIALS

FIGURE III

...ROCTOR ...PTIMUM W.C. %	TRIAXIAL CONSOLIDATION PRESSURE TSF	TESTED γ_D P.C.F.	TESTED W.C. %	PERMEABILITY CM./SEC.	STRENGTH PARAMETERS ϕ' OR ϕ_u DEGREES	STRENGTH PARAMETERS C' OR C_u TSF	CONSOLIDATION PARAMETERS C_c	CONSOLIDATION PARAMETERS C_r	CONSOLIDATION PARAMETERS e_0
8.0	—	132.1	10.8	1×10^{-8}	—	—	—	—	—
8.0	—	119.6	10.6	—	—	—	0.14	0.014	0.455
[illegible].0	2.1 5.2 10.5	125.5 126.1 127.0	11.1 11.1 11.1	—	ϕ_u 21.0	C_u 1.70	—	—	—
8.0	2.1 5.2 10.3	128.2 129.0 129.4	9.5 9.5 9.5	—	ϕ' 27.1	C' 0.56	—	—	—
9.0	—	122.3	12.9	2×10^{-8}	—	—	—	—	—
9.0	—	124.7	13.6	—	—	—	0.15	0.042	0.375 TO 0.470
9.0	2.1 5.2 10.5	122.5 120.9 123.1	12.5 12.5 12.5	— — —	ϕ_u 13.5	C_u 1.60	—	—	—
9.0	2.1 5.2 10.3	120.8 123.6 123.1	12.6 12.6 12.6	— — —	ϕ' 21.3	C' 0.00	—	—	—
14.0	—	115.3	16.3	$<1 \times 10^{-9}$	—	—	—	—	—
6.5	—	134.8	8.2	4×10^{-9}	—	—	—	—	—
—	—	125.0	12.0	1×10^{-8}	ϕ_u = 13.5 ϕ' = 24.2	C_u = 1.60 C' = 0.28	—	—	—

TABLE III

...ORATORY TEST DATA ON CORE MATERIALS

...375-S-38 AND 2375-S-3C.

...VEYED FROM [illegible] AREA
...E APPLICATION FOR DAM CONSTRUCTION.

GROUP DESIGNATION	TEST PIT NUMBER	RANGE OF L.L. % (AVG. L.L.)	RANGE OF P.L. % (AVG. P.L.)	RANGE OF P.I. % (AVG. P.I.)	U.S.C.S. CLASSIFICATION
A_1, A_2	1, 2, 3, 4, 12, 18, 23, 26, 30, 48	25.45 - 34.00 (28.03)	17.93 - 28.20 (22.25)	1.26 - 8.04 (5.78)	ML TO CL - ML
B_1, B_2	5, 11, 17, 19, 29, 35, 38, 39, 44, B, E, F	30.00 - 48.65 (39.70)	19.78 - 29.81 (23.08)	10.19 - 23.58 (15.81)	CL

TABLE I

CLASSIFICATION TEST DATA FOR TYPICAL SOILS

GROUP DESIGNATION	SOIL DESCRIPTION	U.S.C.S. CLASSIFICATION	REPRESENTATIVE SAMPLES
A_1	BROWN CLAYEY SILT - SOME ROCK FRAGMENTS	ML	TEST PIT 3
A_2	GRAY CLAYEY SILT - SOME CLAYSTONE FRAGMENTS (DECOMPOSED CLAYSTONE)	CL - ML	TEST PIT 30
B_1	BROWN SILTY CLAY - TRACE OF ROCK FRAGMENTS	CL	TEST PIT 5
B_2	GRAY SILTY CLAY (DECOMPOSED CLAYSTONE)	CL	TEST PIT 38

TABLE II

VISUAL CLASSIFICATION FOR TYPICAL SOILS

LEGEND

- γ_D = DRY DENSITY
- WC = WATER CONTENT
- ϕ' = EFFECTIVE ANGLE OF INTERNAL FRICTION
- ϕ_u = ANGLE OF INTERNAL FRICTION (TOTAL STRESS ANALYSIS)
- C' = EFFECTIVE COHESION
- C_u = COHESION (TOTAL STRESS ANALYSIS)
- C_c = COMPRESSION INDEX
- C_r = RECOMPRESSION INDEX
- e_0 = INITIAL VOID RATED
- LL = LIQUID LIMIT
- PL = PLASTIC LIMIT
- PI = PLASTICITY INDEX
- SG = SPECIFIC GRAVITY
- TP = TEST PIT

"AS BUILT"

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
SUMMARY OF LABORATORY TEST DATA

REV.	REVISION DESCRIPTION	DATE	BY
4	"AS BUILT" CONDITIONS	7-18-77	TDO
3	[illegible]	12/2/74	T.D.O.
2	ISSUED FOR CONSTRUCTION	9/16/74	T.D.O.
1	ISSUED FOR [illegible] APPROVAL	9/4/74	T.D.O.
0	ISSUED FOR [illegible]	5-28-74	T.D.O.

SCALE AS NOTED

APPROVED [signature]

DATE APRIL 1, 1976

CONTRACT

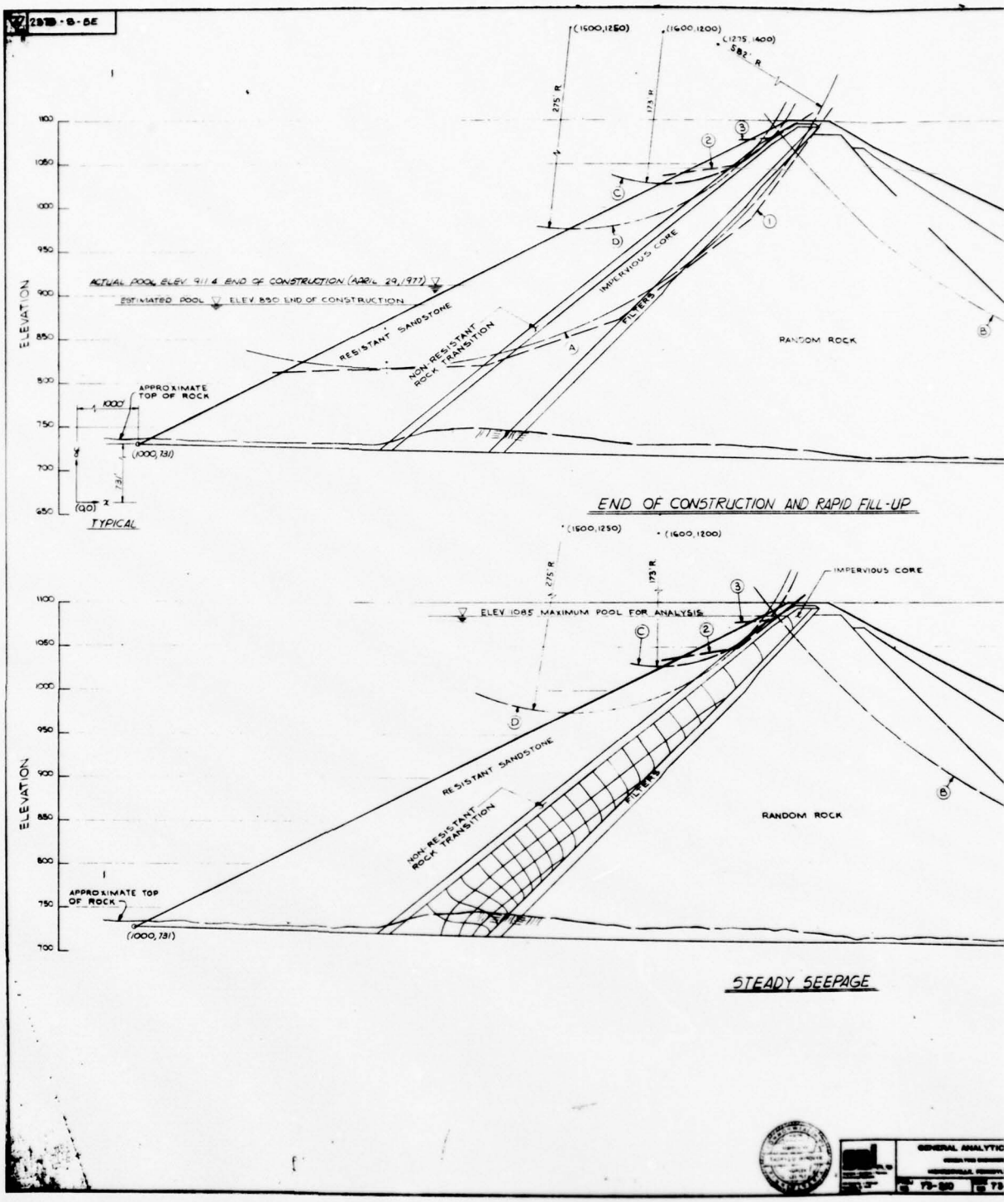
GENERAL ANALYTICS, INC.

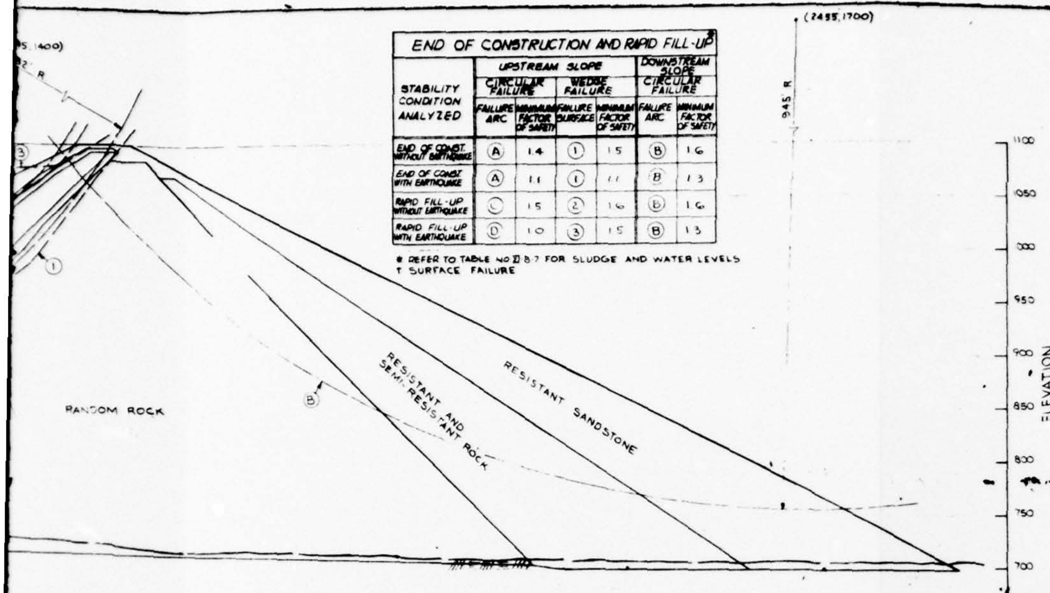
73-210   73-210-[illegible]

PLATE 10

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY		P-24-77	DRAWING NUMBER	76 067-B154
	6-13-79	APPROVED BY		7/24/79		

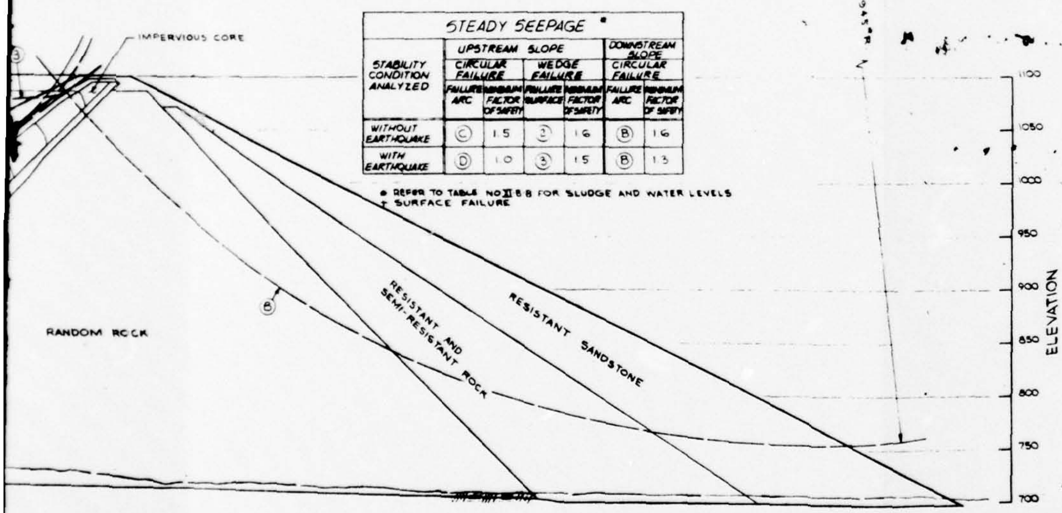




END OF CONSTRUCTION AND RAPID FILL-UP*						
STABILITY CONDITION ANALYZED	UPSTREAM SLOPE				DOWNSTREAM SLOPE	
	CIRCULAR FAILURE		WEDGE FAILURE		CIRCULAR FAILURE	
	FAILURE ARC	MINIMUM FACTOR OF SAFETY	FAILURE SURFACE	MINIMUM FACTOR OF SAFETY	FAILURE ARC	MINIMUM FACTOR OF SAFETY
END OF CONST. WITHOUT EARTHQUAKE	(A)	1.4	(1)	1.5	(B)	1.6
END OF CONST. WITH EARTHQUAKE	(A)	1.1	(1)	1.1	(B)	1.3
RAPID FILL-UP WITHOUT EARTHQUAKE	(C)	1.5	(2)	1.6	(B)	1.6
RAPID FILL-UP WITH EARTHQUAKE	(D)	1.0	(3)	1.5	(B)	1.3

* REFER TO TABLE NO II-B-7 FOR SLUDGE AND WATER LEVELS
† SURFACE FAILURE

...CTION AND RAPID FILL-UP



STEADY SEEPAGE *						
STABILITY CONDITION ANALYZED	UPSTREAM SLOPE				DOWNSTREAM SLOPE	
	CIRCULAR FAILURE		WEDGE FAILURE		CIRCULAR FAILURE	
	FAILURE ARC	MINIMUM FACTOR OF SAFETY	FAILURE SURFACE	MINIMUM FACTOR OF SAFETY	FAILURE ARC	MINIMUM FACTOR OF SAFETY
WITHOUT EARTHQUAKE	(C)	1.5	(2)	1.6	(B)	1.6
WITH EARTHQUAKE	(D)	1.0	(3)	1.5	(B)	1.3

* REFER TO TABLE NO II-B-8 FOR SLUDGE AND WATER LEVELS
† SURFACE FAILURE

STEADY SEEPAGE

SCALE 1" = 50'

NOTE:
REFER TO DWG. Nº 2375-S-5C FOR DESIGN PARAMETERS

'AS BUILT'

POWER PLANT WASTE DISPOSAL
BRUCE MANSFIELD PLANT
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
STABILITY ANALYSIS-CREST ELEVATION [illegible]

REV.	REVISION DESCRIPTION	DATE	BY
4	'AS BUILT' CONDITIONS	7-18-77	T.D.D.
3	GENERAL REVISION ISSUED FOR CONSTRUCTION	12-2-74	T.D.D.
2	CROSS-SECTION REVISIONS SUPERIMPOSED ON ORIGINAL CROSS-SECTIONS, NOTES ADDED TO TABLES & NEW TABLES ADDED	9-30-74	T.D.D.
1	ISSUED FOR D.E.R. APPROVAL	4/1/74	T.D.D.
0	ISSUED FOR CLIENT INFORMATION AND COMMENT	[illegible]	[illegible]

SCALE 1" = 50'

APPROVED [illegible]
DATE APRIL [illegible]
CONTRACT

GENERAL ANALYTICS, INC.

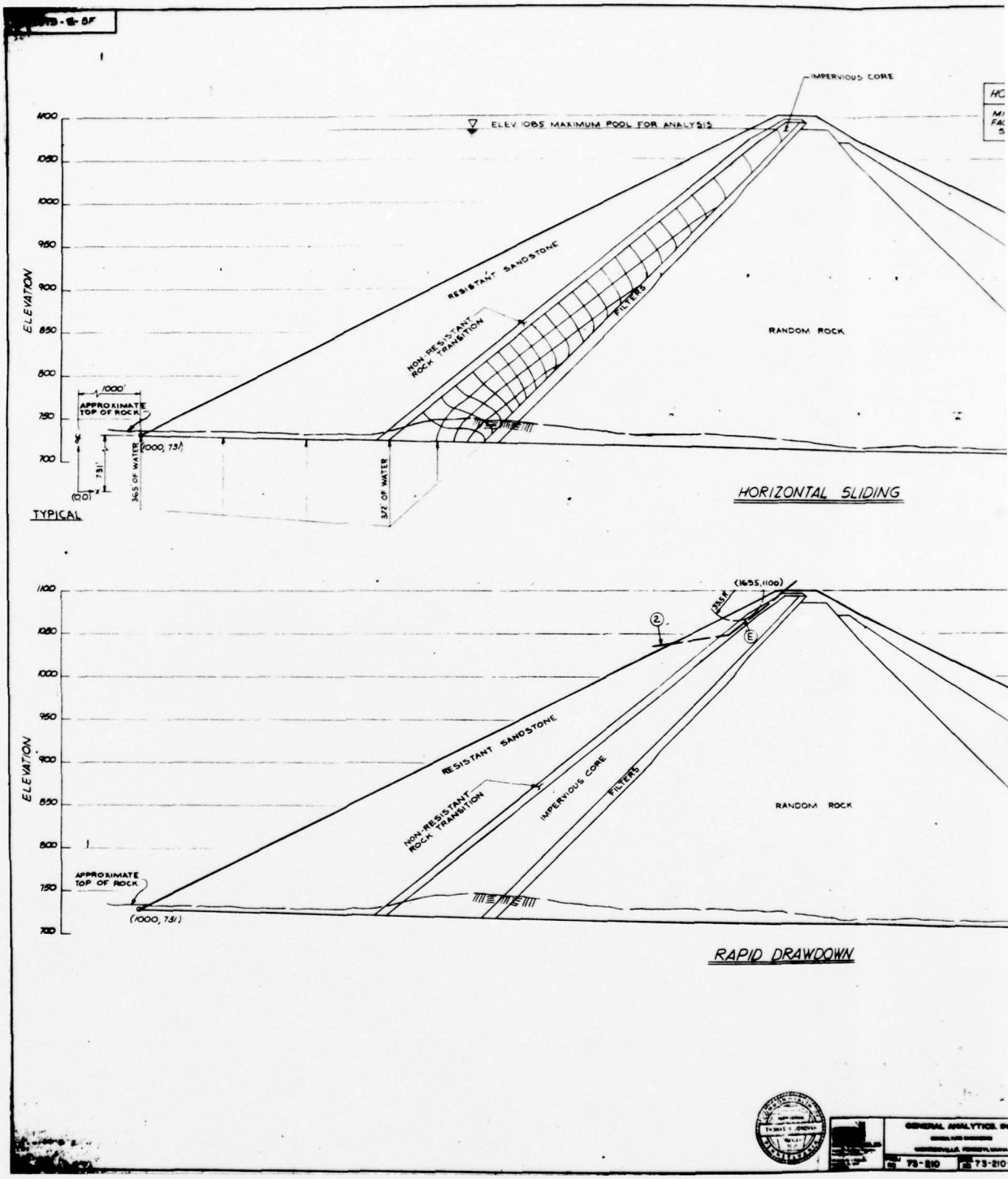
73-210 | 73-210-M27

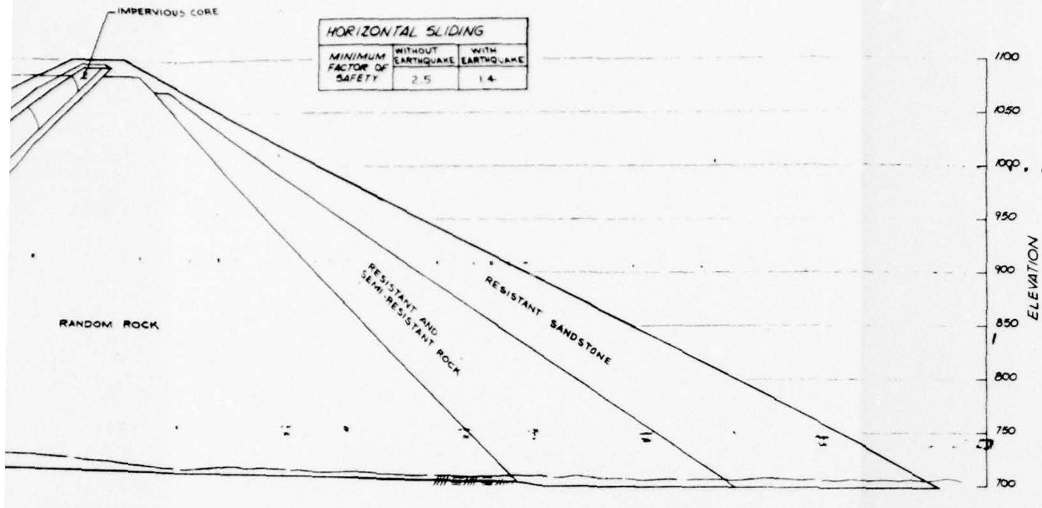
PLATE II

D'APPOLONIA

2

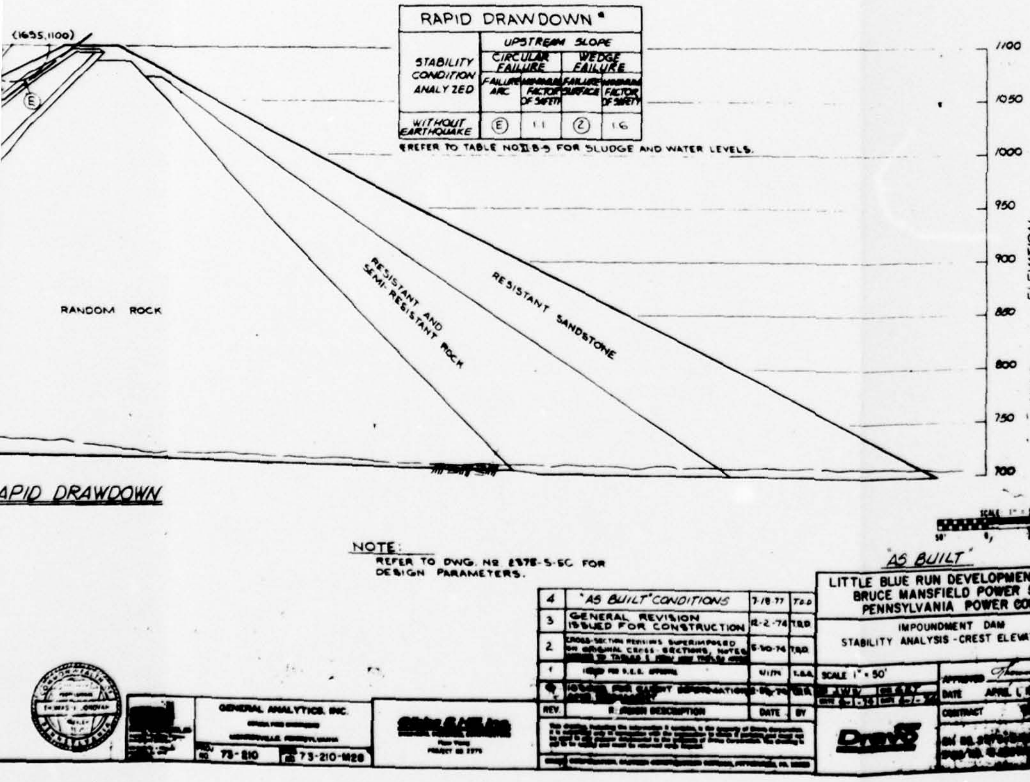
DRAWN BY	ACS	CHECKED BY	BE	7-24-79	DRAWING NUMBER 76-867-B155
	6-13-79	APPROVED BY	JMP	7/26/79	





HORIZONTAL SLIDING		
MINIMUM FACTOR OF SAFETY	WITHOUT EARTHQUAKE	WITH EARTHQUAKE
	2.5	1.4

HORIZONTAL SLIDING



RAPID DRAWDOWN*				
STABILITY CONDITION ANALYZED	UPSTREAM SLOPE			
	CIRCULAR FAILURE		WEDGE FAILURE	
	FAILURE ARC	MINIMUM FACTOR OF SAFETY	FAILURE SURFACE	MINIMUM FACTOR OF SAFETY
WITHOUT EARTHQUAKE	(E)	1.1	(2)	1.6

*REFER TO TABLE NO. II B-5 FOR SLUDGE AND WATER LEVELS.

...APID DRAWDOWN

NOTE:
REFER TO DWG. NO. 2378-S-5C FOR DESIGN PARAMETERS.

SCALE 1" = 50'

"AS BUILT"

LITTLE BLUE RUN DEVELOPMENT AR...
BRUCE MANSFIELD POWER STATI...
PENNSYLVANIA POWER COMPANY

IMPOUNDMENT DAM
STABILITY ANALYSIS - CREST ELEVATION ...

REV.	DESCRIPTION	DATE	BY
4	"AS BUILT" CONDITIONS	7-18-77	T.D.D.
3	GENERAL REVISION ISSUED FOR CONSTRUCTION	12-2-74	T.B.D.
2	CROSS-SECTION REVISIONS SUPERIMPOSED ON ORIGINAL CROSS-SECTIONS, NOTES ...	5-30-74	T.B.D.
1	[illegible]	[illegible]	[illegible]

SCALE 1" = 50'

APPROVED

DATE APRIL ...

CONTRACT

GENERAL ANALYTICS, INC.

73-210

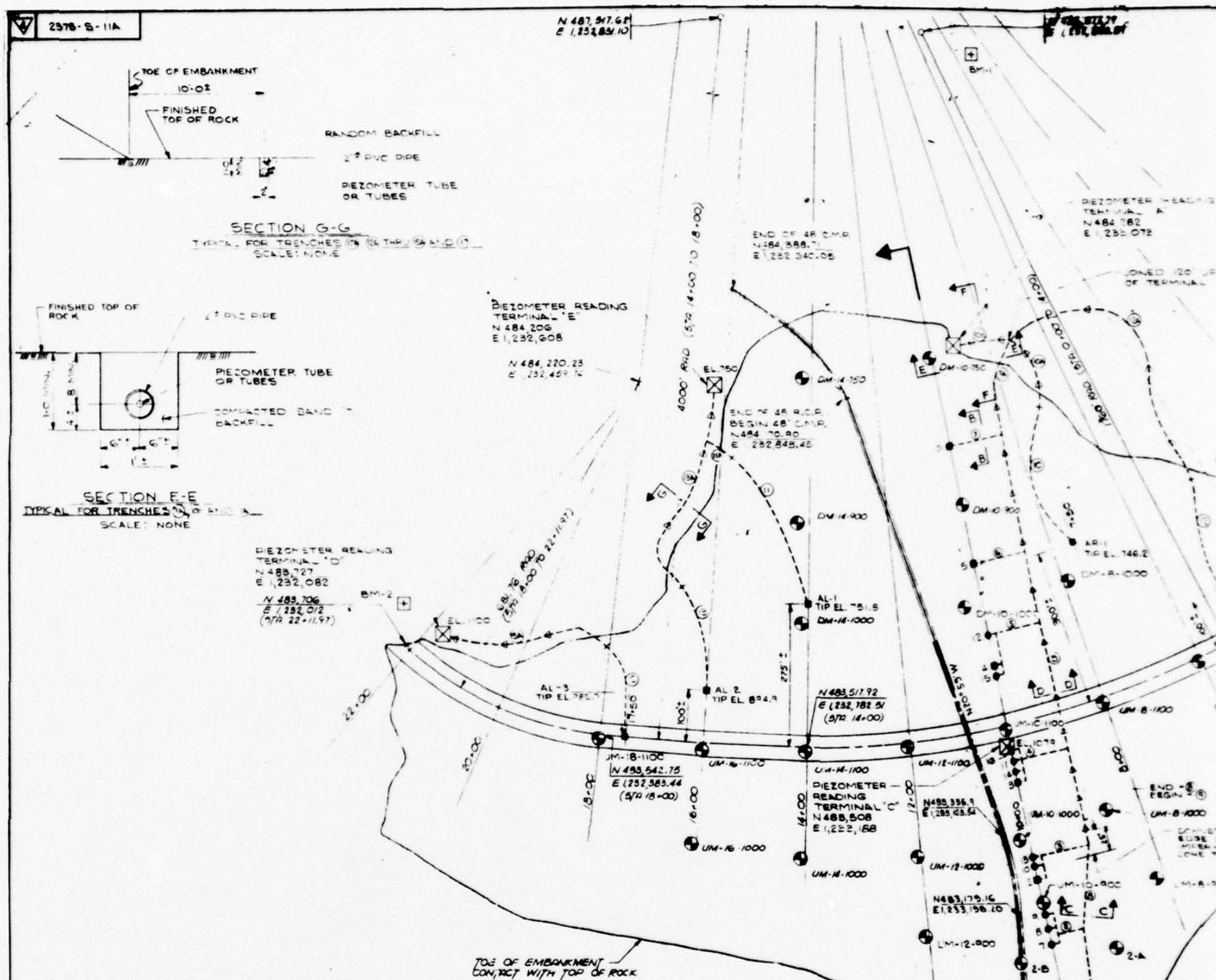
73-210-M28

PLATE 12

D'APPOLONIA

2

DRAWN BY	ACS 6-13-79	CHECKED BY	BE 7-24-79	DRAWING NUMBER	7_ _67-B156
		APPROVED BY	JHP 7/20/79		



PIEZOMETER INSTALLATION SCHEDULE

1. EMBANK. PIEZOMETERS AND FOUNDATION PIEZOMETERS 1 THRU 4 TO BE INSTALLED DURING CONSTRUCTION OF FIRST YEAR EMBANKMENT.
2. FOUNDATION PIEZOMETERS 5 AND 6 TO BE INSTALLED BEFORE OVERLYING FILL HEIGHT EXCEEDS 50 FEET.
3. FOUNDATION PIEZOMETERS AL-1 THRU AL-3 AND AR-1 THRU AR-3 TO BE INSTALLED WHEN FILL SURFACE REACHES PLAN LOCATION OF GIVEN PIEZOMETER.
4. PIEZOMETER TUBE TRENCHES (1) THRU (7), (10) AND (11) TO BE INSTALLED IMMEDIATELY AFTER INSTALLATION OF CORRESPONDING PIEZOMETERS SERVED.
5. PIEZOMETER TUBE TRENCHES (16) AND (17) TO BE INSTALLED WITHIN 2 MONTHS AFTER INSTALLATION OF PIEZOMETERS AL-1 THRU AL-3 AND AR-1 THRU AR-3.
6. PIEZOMETER READING TERMINALS TO BE INSTALLED WITHIN ONE MONTH AFTER INSTALLATION OF CORRESPONDING PIEZOMETERS SERVED.

FOR AS BUILT INSTALLATION SCHEDULE SEE TABLE 1 UNDER "AS BUILT" NOTES

"AS BUILT" NOTES:

1. FOR COORDINATES AND ELEVATIONS OF SURFACE MONUMENTS SEE TABLE 5 IN THE EMBANKMENT MONITORING MANUAL.
2. FOR PIEZOMETER TIP ELEVATIONS AND COORDINATES SEE TABLE 2 IN THE EMBANKMENT MONITORING MANUAL.

TABLE 1 - PIEZOMETER INSTALLATION DATES

PIEZOMETERS	INSTALLATION DATES
1 THRU 4 AND 7 THRU 15	MAY 2 THRU MAY 17, 1975
5 AND 6	MAY 29 THRU JUNE 2, 1975
AL-1 AND AR-1	NOV. 7 THRU NOV. 24, 1975
AL-2 AND AR-2	MAR. 8 THRU MAR 16, 1976
AL-3 AND AR-3	SEPT. 29 THRU OCT. 5, 1976
78	MAR. 20, 1977

BM-3

LEGEND

- SURFACE MONUMENT - SEE DETAIL 'E' FOR INSTALLATION DETAILS
- BENCH MARK
- UM-12-900 - SURFACE MONUMENT DESIGNATION (UPSTREAM AT STATION 12+00 - ELEV. 900)
- (N482,751.77, E1,233,227.71) TEMP. DIVERSION PIPE ℄ COORDINATES SUPPLIED BY DRAVO CORPORATION.
- N60°59'W - TEMP. DIVERSION PIPE ℄ BEARING SUPPLIED BY DRAVO CORPORATION
- FOUNDATION PIEZOMETER / EMBANKMENT PIEZOMETER } SEE DWG. 2375-S-13B FOR INSTALLATION DETAILS
- PIEZOMETER TUBE TRENCHES (SEE SECTIONS B-B THRU G-G FOR DETAILS)

GENERAL ANALYTICS INC.

73-210-... 73-210-...

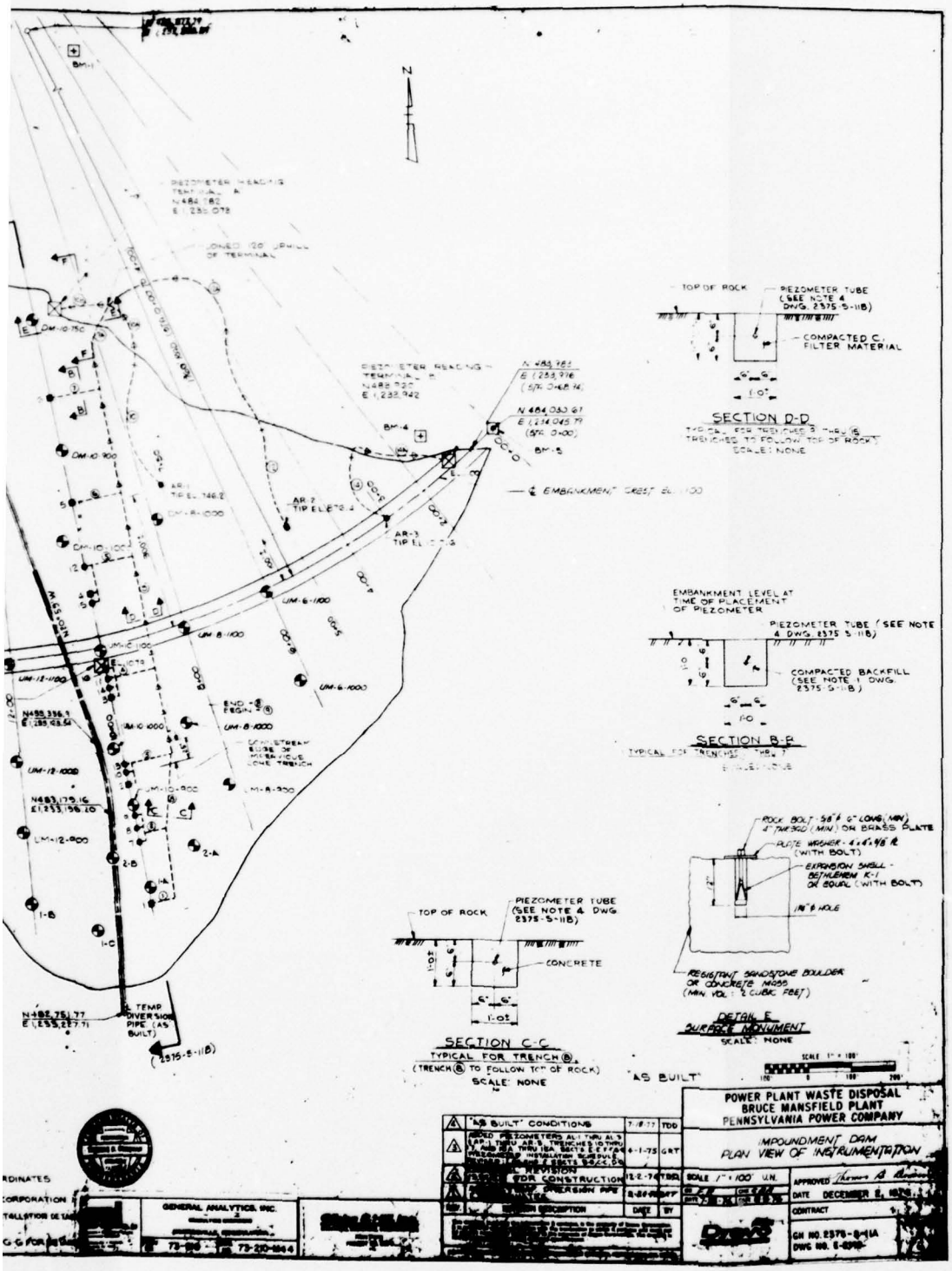
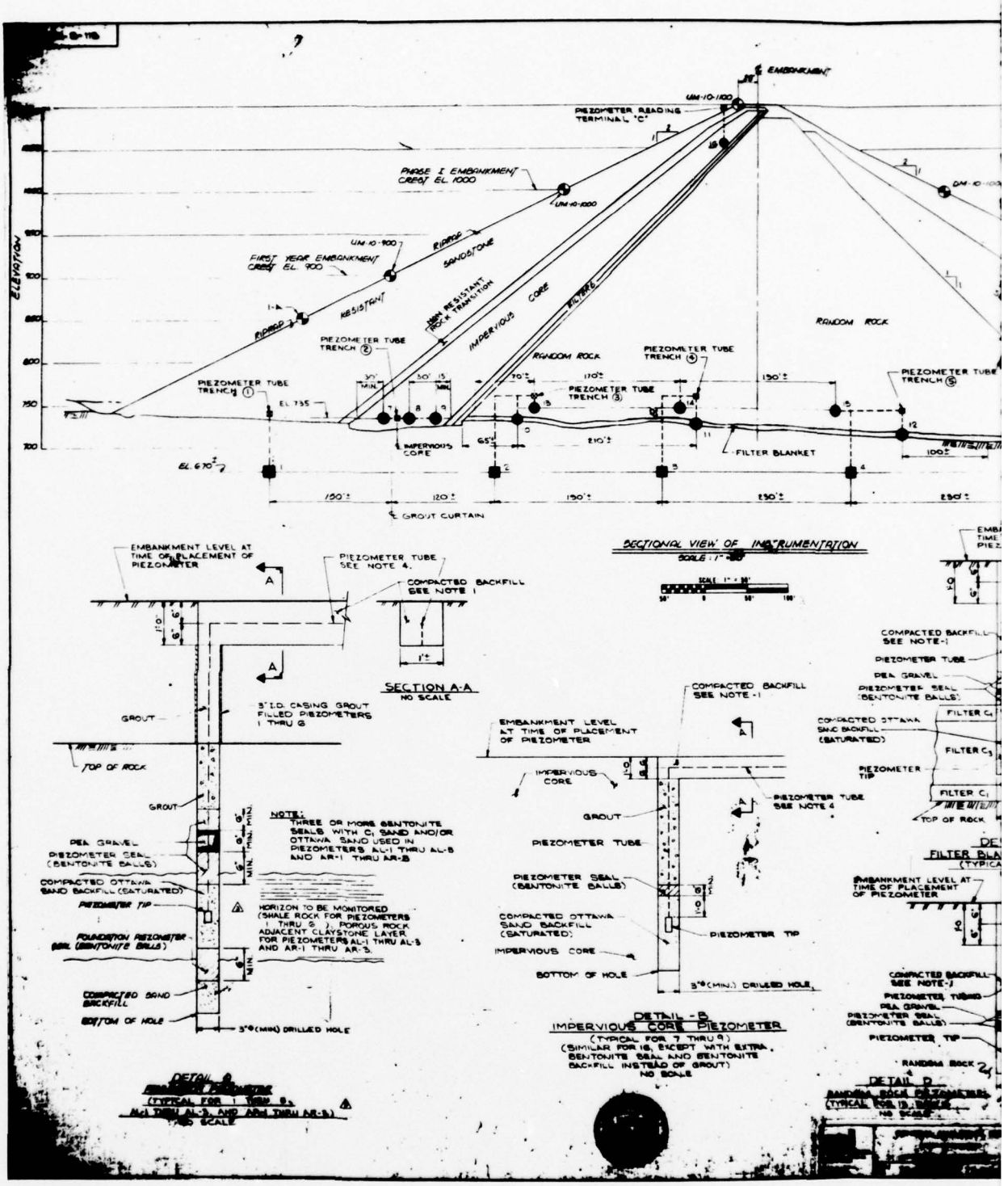


PLATE 13

2

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY		7-24-79	DRAWING NUMBER 76 J67-B157
	6-13-79	APPROVED BY		7/26/79	



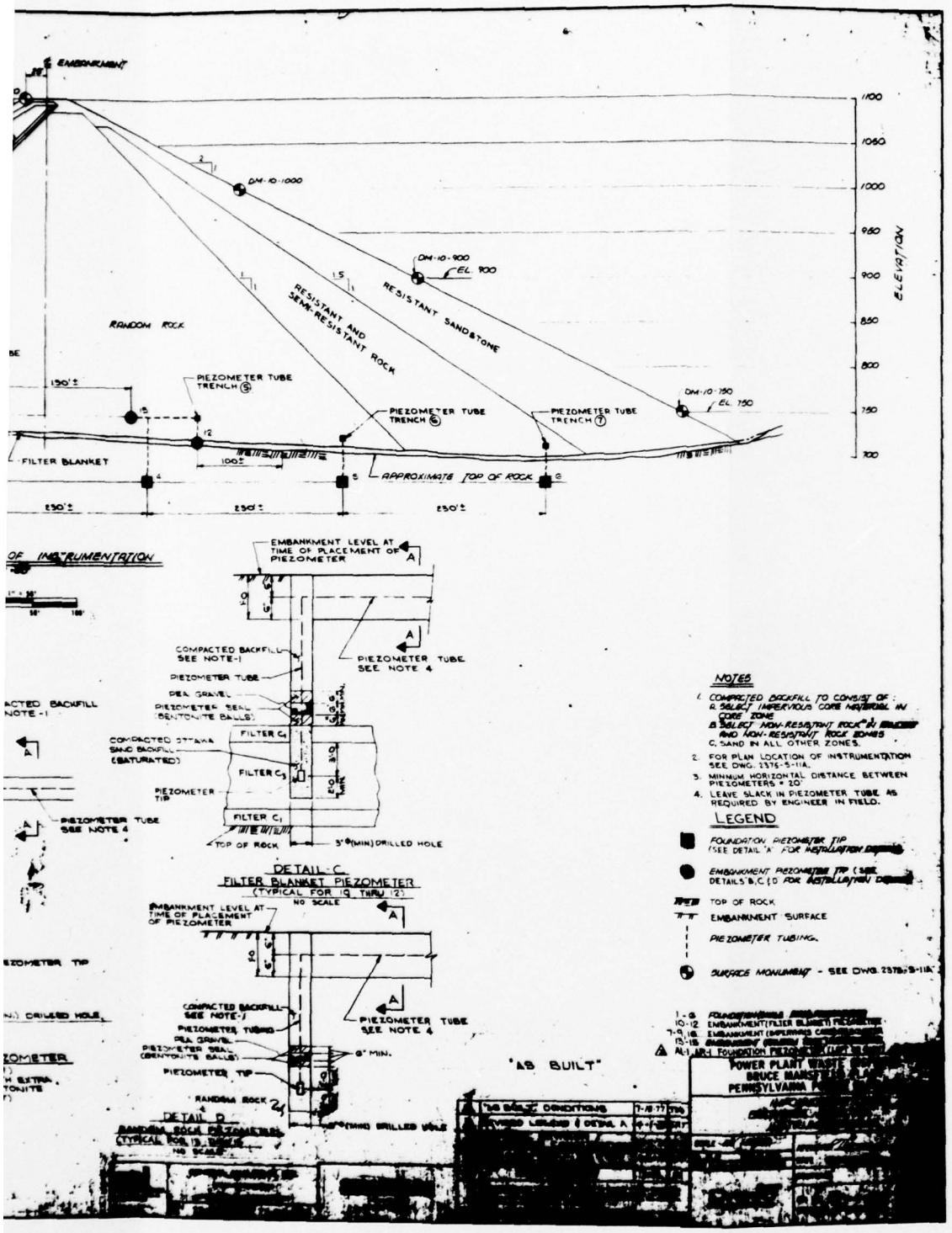
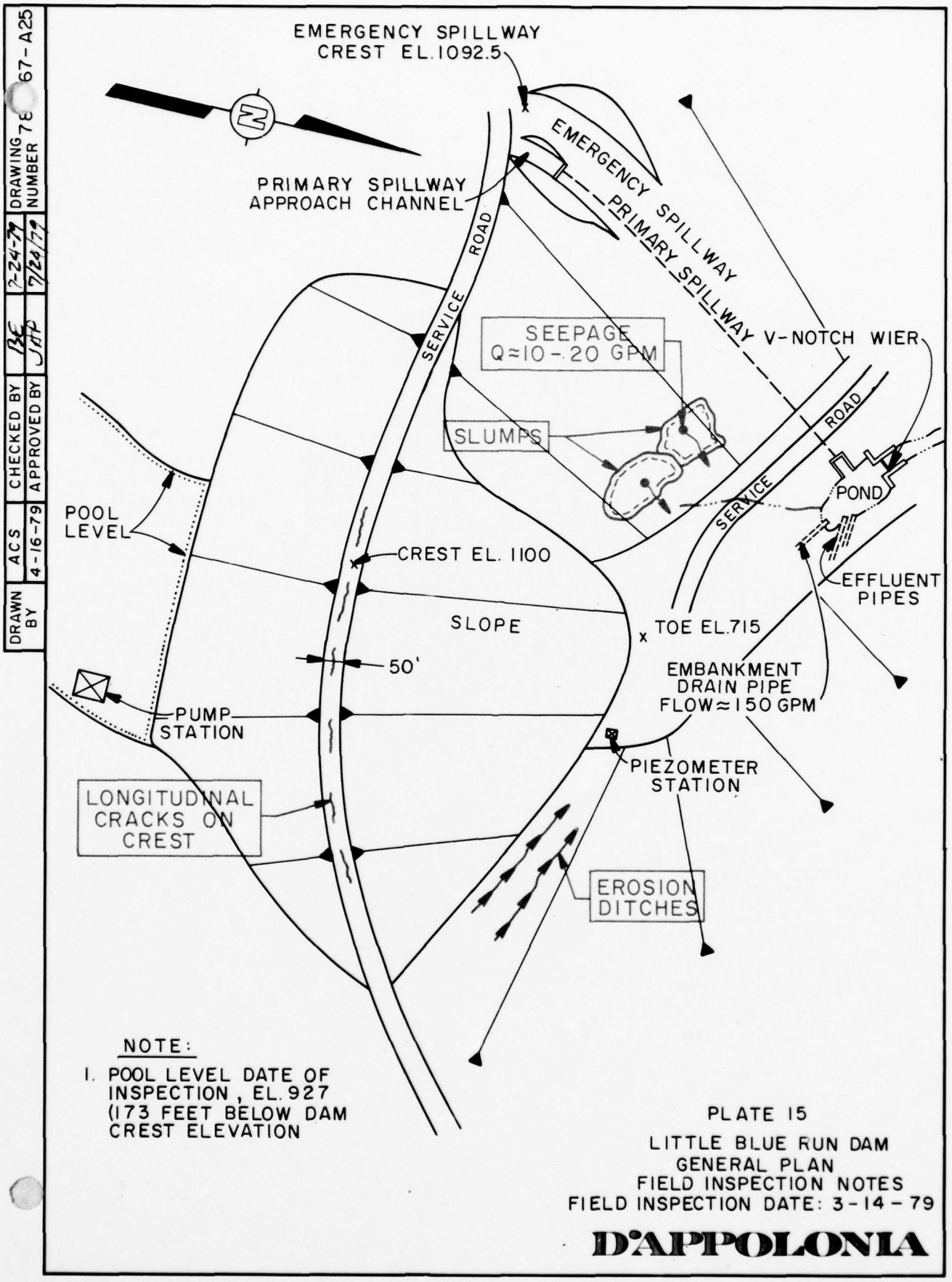


PLATE 14

2

D'APPOLONIA



NOTE:

1. POOL LEVEL DATE OF INSPECTION, EL. 927 (173 FEET BELOW DAM CREST ELEVATION

PLATE 15

LITTLE BLUE RUN DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: 3-14-79

D'APPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Little Blue Run Dam COUNTY Hancock, WV Beaver, PA STATE West Virginia and Pennsylvania ID# NDI I.D. PA-917 DER I.D. 4-49

TYPE OF DAM Rockfill HAZARD CATEGORY High

DATE(S) INSPECTION March 14, 1979 WEATHER Cloudy TEMPERATURE 40s

POOL ELEVATION AT TIME OF INSPECTION 927 M.S.L. TAILWATER AT TIME OF INSPECTION 850+ M.S.L.

INSPECTION PERSONNEL:	REVIEW INSPECTION PERSONNEL: (April 16, 1979)
Bilgin Erel	L. D. Andersen
Wah-Tak Chan	J. H. Poellot
	B. Erel

Bilgin Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	There are numerous longitudinal cracks along the crest of the dam.	The extent of cracking on the crest should continue to be monitored.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There are several small slumps along the left abutment at approximately Elevation 740.	These slumps should be periodically inspected.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No misalignment was observed. It was reported that monuments along the crest are periodically surveyed.	
RIPRAP FAILURES	None.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No seeps of distress. Minor erosion along the right abutment.	
ANY NOTICEABLE SEEPAGE	None found.	
STAFF GAGE AND RECORDER	None.	
DRAINS	Embankment toe drain discharges into a pond approximately 300 feet downstream from the toe of the dam. The flow is estimated to be approximately 150 gallons per minute.	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The dam has no outlet works.	
INTAKE STRUCTURE	Not applicable.	
OUTLET STRUCTURE	Not applicable.	
OUTLET CHANNEL	Not applicable.	
EMERGENCY GATE	Not applicable.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete weirs of the primary and emergency spillways are in good condition.	
APPROACH CHANNEL	Free of debris and obstructions.	
DISCHARGE CHANNEL	In good condition.	
BRIDGE AND PIERS	None.	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	See Plates 13 and 14 for the locations of settlement gauges.	
OBSERVATION WELLS	None.	
WEIRS	Flow through the embankment drainpipe is monitored by the owner.	
PIEZOMETERS	See Plates 13 and 14 for locations.	
OTHER	None.	

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep to moderately steep.	
SEDIMENTATION	Unknown.	
UPSTREAM RESERVOIRS	None.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are no obstructions that would affect the discharge capacity of the spillways.	
SLOPES	In good condition.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	There are no inhabitable structures in Little Blue Run valley. Failure of the dam may cause loss of life and property damage in the communities along the Ohio River, downstream from the dam.	

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
AND HYDROLOGIC AND HYDRAULIC
PHASE I

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Little Blue Run Dam

ID# NDI I.D. PA-917
DER I.D. 4-49

ITEM	REMARKS
AS-BUILT DRAWINGS	Available in the state files.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed by General Analytics, Inc., of Monroeville, Pennsylvania, and Gibbs & Hill, Consulting Engineers, of New York, New York. The dam was constructed by Dravo Corporation with completion in May 1977.
TYPICAL SECTIONS OF DAM	See Plate 3.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	The dam has no outlet.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not available.
DESIGN REPORTS	Included in the state files.
GEOLOGY REPORTS	Included in the state files.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Stability and seepage studies are included in state files.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Included in state files.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	The settlement monuments on the embankment are periodically surveyed.
BORROW SOURCES	Indicated in the engineers's report.
MONITORING SYSTEMS	See Plates 13 and 14.
MODIFICATIONS	None reported.
HIGH POOL RECORDS	Pool level on date of inspection Elevation 927 (approximately 160 feet below the spillway crest level).

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	The cracking problem on the crest of the dam is being investigated by GAI Consultants, Inc., of Monroeville, Pennsylvania.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	Maintained by the owner.
SPILLWAY PLAN SECTIONS DETAILS	See Plates 8 and 9.
OPERATING EQUIPMENT PLANS AND DETAILS	The dam has no operating equipment.

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 2.93 square miles

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 1089.6 (63,900 acre-feet)

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 1100 (73,000 acre-feet)

ELEVATION; MAXIMUM DESIGN POOL: 1097.6 (maximum pool level during PMF)

ELEVATION; TOP DAM: 1100 (as designed)

SPILLWAY: (Emergency)

a. Elevation 1092.5

b. Type Trapezoidal earth channel

c. Width 30 feet (base width perpendicular to flow)

d. Length 350± feet

e. Location Spillover None

f. Number and Type of Gates None

OUTLET WORKS:

a. Type (The dam has no outlet works).

b. Location Not applicable

c. Entrance Inverts Not applicable

d. Exit Inverts Not applicable

e. Emergency Draindown Facilities Not applicable

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

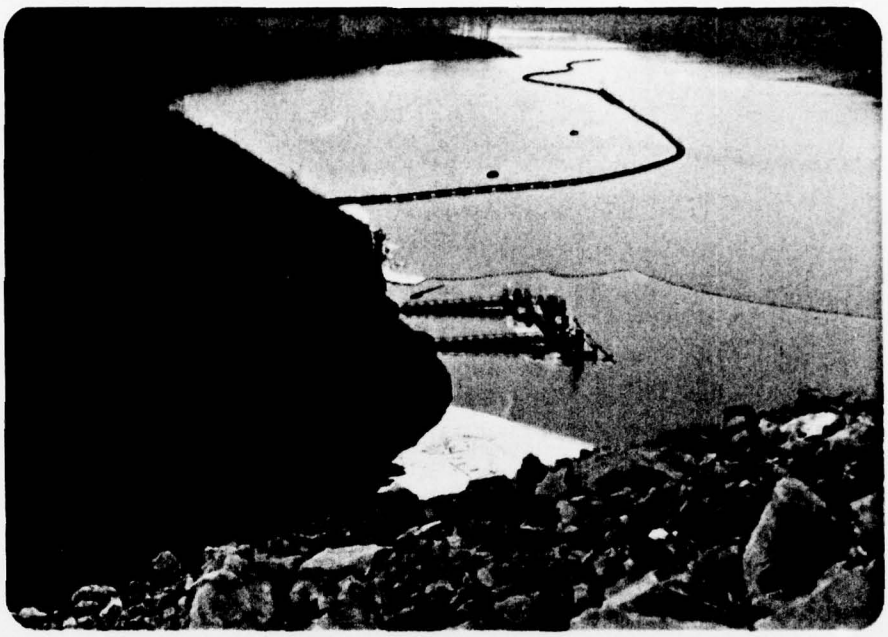
c. Records None

MAXIMUM NONDAMAGING DISCHARGE: Spillway capacity

APPENDIX C
PHOTOGRAPHS

LIST OF PHOTOGRAPHS
LITTLE BLUE RUN DAM
NDI I.D. NO. PA-917
MARCH 14, 1979

PHOTOGRAPH NO.	DESCRIPTION
1	Reservoir. Background: sludge inflow line. Foreground: effluent pump station. (Pool level about 170 feet below dam crest).
2	Crest (looking west).
3	Right abutment. Note erosion ditches.
4	Left abutment. Note oil barrel at the toe for scale.
5	Left abutment. View from crest.
6	Effluent discharge pipes left. Toe drain right.
7	Primary spillway intake structure.
8	Primary spillway discharge structure.
9	Longitudinal cracks near upstream side of the crest.
10	Settlement monument on crest (typical).
11	Piezometer monitoring station.
12	Downstream area. Ohio River in background.



Photograph No. 1

Reservoir. Background: sludge inflow line. Foreground: effluent pump station. (Pool level about 170 feet below dam crest).

Photograph No. 2

Crest (looking west).

Photograph No. 3

Right abutment. Note erosion ditches.

Photograph No. 4

Left abutment. Note oil barrel at the toe for scale.

Photograph No. 5

Left abutment. View from crest.

Photograph No. 6

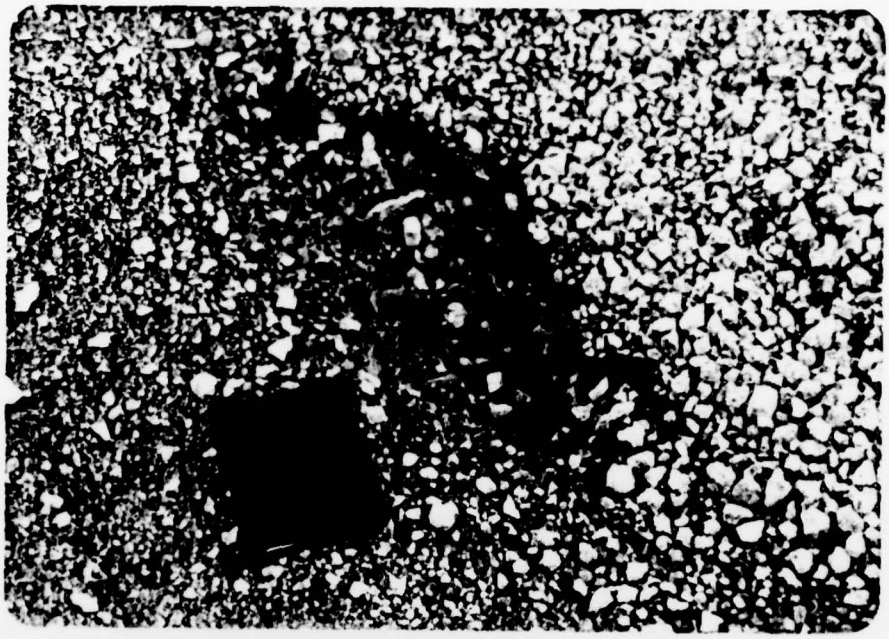
Effluent discharge pipes left. Toe drain right.

Photograph No. 7

Primary spillway intake structure.

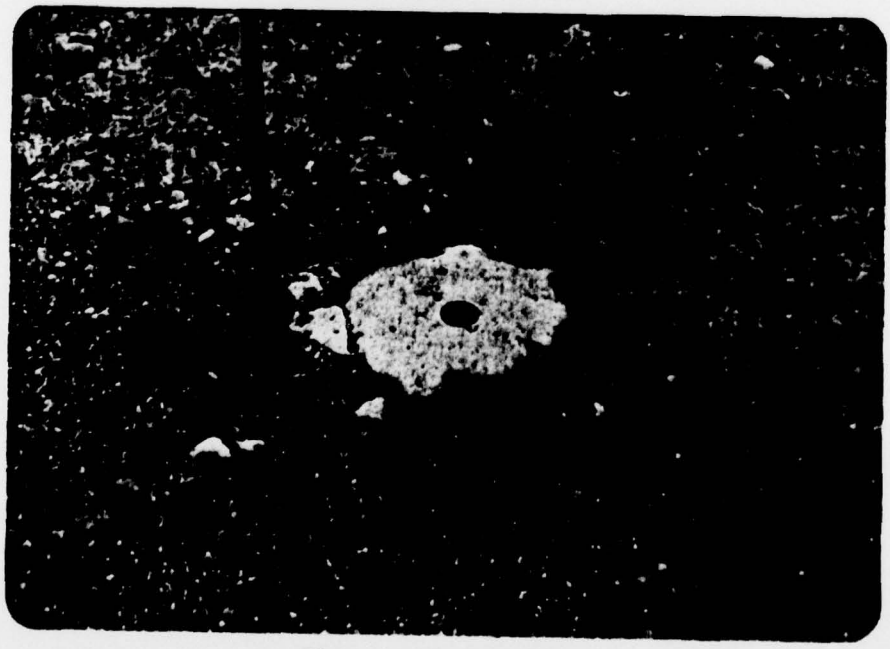
Photograph No. 8

Primary spillway discharge structure.



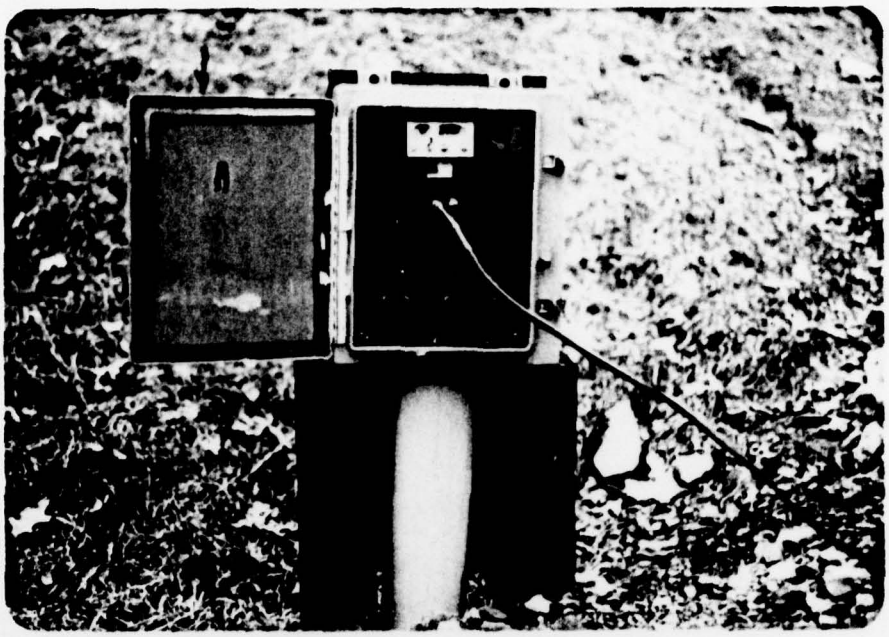
Photograph No. 9

Longitudinal cracks near upstream side of the crest.



Photograph No. 10

Settlement monument on crest (typical).



Photograph No. 11

Piezometer monitoring station.

Photograph No. 12

Downstream area. Ohio River in background.

APPENDIX D

REGIONAL GEOLOGY

APPENDIX D
REGIONAL GEOLOGY

The valley walls and floors of Little Blue Run and its tributaries are underlain by rock strata of Middle Pennsylvania Age, the Allegheny and Conemaugh formations.

The Allegheny Formation consists primarily of sandstone, sandy shale, and shale with lesser amounts of claystone, limestone and coal. The overlying Conemaugh Formation consists of shale, claystone, and sandy shale with lesser amounts of sandstone, limestone and coal. Within the reservoir, bedrock is formed by the upper 220 feet of the Allegheny Formation and the lower 170 feet of the Conemaugh Formation.

An evaluation of the mineral resources within the project development was made in conjunction with the design of the dam, and no mineral resources of commercial value that might be exploited in the foreseeable future were found to occur within the watershed or below the valley floor of Little Blue Run.

Seismicity at the project site has been evaluated. No evidence of major tectonic faulting has been reported within 100 miles of the site.

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER 7b-367-A21
	2-5-79	APPROVED BY		

SCALE

0 1 2 3 4 5 miles

BRADY, J.C. BACON, RACCOON CREEK AND LITTLE BLUE RUN DAMS GEOLOGY MAP

REFERENCE:

GREATER PITTSBURGH REGION GEOLOGIC MAP COMPILED BY W.R. WAGNER, J.L. CRAFT, L. HEYMAN AND J.A. HARPER, DATED 1975, SCALE 1:125000

DAMPDIADNIA

DRAWN BY	ACS	CHECKED BY	BE	DRAWING NUMBER	7C 367-A22
	2-5-79	APPROVED BY	[illegible]		2 of 4

GROUP	FORMATION		DESCRIPTION
	Alluvium Terrace deposits	Qt	Sand, gravel, clay. Sand, clay, gravel on terraces above present rivers; includes Carmichaels Formation.
DUNKARD	Greene		Cyclic sequences of sandstone, shale, red beds, thin limestones and coals.
DUNKARD	Washington	Pw	Cyclic sequences of sandstone, shale, limestone, and coal; contains Washington coal bed at base.
DUNKARD	Waynesburg		Cyclic sequences of sandstone, shale, limestone and coal; contains Waynesburg coal bed at base.
MONONGAHELA		Pm	Cyclic sequences of shale, limestone, sandstone and coal; contains Pittsburgh coal bed at base.
CONEMAUGH	Casselman	Pcc	Cyclic sequence of sandstone, shale, red beds and thin limestone and coal.
CONEMAUGH	Ames		
CONEMAUGH	Glenshaw	Pcg	Cyclic sequences of sandstone, shale, red beds and thin limestone and coal; several fossiliferous limestone; Ames limestone bed at top.
ALLEGHENY	Vanport	Pa	Cyclic sequences of shale, sandstone, limestone, and coal; contains Brookville coal at base and Upper Freeport coal at top; within group are the commercial Vanport limestone and Kittanning and Clarion coals.

GEOLOGY MAP LEGEND

REFERENCE:

GREATER PITTSBURGH REGION GEOLOGIC MAP
COMPILED BY W.R. WAGNER, J.L. CRAFT, L. HEYMAN
AND J.A. HARPER, DATED 1975, SCALE 1:125000

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